Master Thesis

Water Risk Assessments in Tourist Destinations and Water Stewardship for Sustainable Tourism Practices

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This thesis has been formed by countless contributions, and I would like to use this space to express my deepest appreciation to those who guided, supported, and inspired me along the way.

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Abstract

Tourism is a water-intensive sector which highly impacts water availability, quality, and equity, and is increasingly scrutinized amidst climate change and growing competition for water resources. This thesis assesses water-related risks in a global portfolio of hotel destinations operated by a multinational tourism company, focusing on high-risk locations and the applicability of the Alliance for Water Stewardship (AWS) Standard in guiding equitable and context-sensitive water management. Using a mixed-method approach, the study integrates quantitative screening using the World Resources Institute's Aqueduct Water Risk Atlas and the World Wide Fund for Nature's Water Risk Filter with qualitative desk research and an operational risk questionnaire. The PRR framework, covering physical, regulatory, and reputational risks is used to structure the analysis. From 361 destinations across 37 countries, a total of 25 in five high-risk countries (Spain, Greece, Turkey, Mexico, and Egypt) were selected based on water risk severity and operational significance. Detailed basin- and site-level assessments revealed critical vulnerabilities including extreme baseline water stress, high seasonal variability, inadequate governance capacity, and reputational risks linked to water equity concerns. The AWS Standard offers a strong and flexible framework for site- and catchment-level action but requires adaptation to tourism-specific contexts. The study recommends integrating water equity into stewardship strategies, prioritizing high-impact sites, and leveraging risk assessment tools to align corporate water stewardship with local governance and community needs. Findings contribute to sustainable tourism practice by linking technical risk metrics with governance, equity, and strategic decision-making in the tourism sector.

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List of Abbreviations and Acronyms

AWS	Alliance For Water Stewardship
BAU30	Future Water Stress
BWS	Baseline Water Stress
DSİ	State Hydraulic Works
DWRI	Destination Water Risk Index
FAO	Food And Agriculture Organization of the United Nations
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resources Management
PRR	Physical, Reputational, and Regulatory Water Risk
SCM	Supply Chain Management
SDG	Sustainable Development Goals
SEV	Seasonal Variability
WASH	Water, Sanitation, and Hygiene
WBCSD	World Business Council for Sustainable Development
WFD	Water Framework Directive
WRI	World Resources Institute
WTTC	The World Travel and Tourism Council
WWF	World Wide Fund for Nature
WWTP	Wastewater Treatment Plant

1. Introduction

1.1. Background

The tourism industry operates globally, and water is a crucial element of its operations, consumed in accommodations and used for recreational activities (Ricart et al., 2023). The World Travel and Tourism Council (WTTC) estimates that tourism accounts for between 3.5% and 5.8% of global water consumption, both direct and indirect (WTTC, 2023). Direct consumption, such as tourists using water in accommodations and recreational facilities, makes up 20% of this total. Indirect consumption includes water used for transportation and food production within the tourism supply chain (Tervoort & Langergraber, 2024). Tourism water consumption can be highly concentrated in certain regions and peak seasons, leading to potential depletion of local resources (Skrimizea & Parra, 2019) and even conflicts with local communities (Hadjikakou et al., 2012).

Water stress in tourism destinations is exacerbated by climate change. The Intergovernmental Panel on Climate Change (IPCC) confidently predicts an increase in hydrological droughts, more frequent and intense heatwaves, extreme rainfall events, and a decline in annual precipitation (IPCC, 2023). These changes affect investment, planning, and operations in the tourism sector, ultimately influencing the competitiveness, sustainability, and geographic appeal of destinations (Roson & Sartori, 2014; Scott, 2021). For example, in Mediterranean destinations, severe water scarcity occurs in summer due to low rainfall, increased agricultural demand, and urban consumption, simultaneously with peak tourism seasons (Liu et al., 2021; Ricart et al., 2020).

Water resources are unequally distributed across regions and seasons, posing further challenges for sustainable tourism management. In regions with higher water stress, tourism is often responsible for a larger percentage of water use. In 2019, 69% of the sector's total water consumption came from areas experiencing medium to extremely high water stress (WTTC, 2023). The lockdown period of COVID-19 has also highlighted the sector's significant role in water consumption. For instance, in the Balearic Islands, water use dropped by 58% in high-tourism areas, compared to only 14% in low-tourism areas, demonstrating tourism's substantial impact on local water demand (García et al., 2022).

Water risks refer to the possibility of water-related challenges, such as water scarcity, water stress, flooding, infrastructure decay, and drought. The extent of the risk depends on the severity of the challenge's impact and the probability of the challenge occurring, while the severity of the impact depends on the intensity of the challenge and the vulnerability of the concerned actor (CEO Water Mandate, 2019). Many water-related challenges create risks for various sectors and organizations. From a business perspective, increasing climate pressures and stakeholder expectations push the tourism sector toward sustainable water management (Mdoda et al., 2024). Given the declining water availability, water management in mass tourism destinations is crucial (Tuel & Eltahir, 2020). The tourism sector relies on both water quantity and quality, rendering water stewardship practices essential (Sustainable Hospitality Alliance, 2018). As Becken (2014) demonstrates, disparities between tourist and local water use can reach up to eightfold in developing countries such as Egypt and Sri Lanka, raising critical concerns about water equity. These imbalances underscore the need for water stewardship approaches that go beyond operational efficiency to address broader ethical and governance dimensions at the destination level.

The concept of corporate water stewardship describes a gradual engagement process, starting with internal water efficiency improvements, progressing to collaborative value chain efforts, and eventually leading to policy engagement (Hepworth, 2012; WWF, 2013; Morgan, 2018). Water stewardship is important to ensure just and equitable access to water and is rooted in responsible and robust water governance (Singh et al., 2023). This approach integrates water management and governance, emphasizing water security as the driving effort (Sojamo & Rudebeck, 2024).

This thesis is part of a research internship position that I had in a tourism company. The company has several operations, including hotels and resorts, cruises, airlines, and tour operators. However, this thesis only covers operations in hotels and resorts. The company has a diverse portfolio of hotels and resorts in Africa, Asia, Europe, North America and South America. The destinations face varied water challenges due to differences in geographical and socio-political factors. For instance, Mediterranean countries have experienced significant drying trends over the past century (Hoerling et al., 2012; Kelley et al., 2015). East and Southeast Asian destinations face growing risks of climate-related water disasters, while infrastructure constraints limit their ability to meet demands (Lee et al., 2024). The company's sustainability agenda is to engage in water stewardship actions across their value chain. As such, this thesis aims to assess water risks in various destinations, as well as establishing a framework to mitigate these risks. I conducted water risk assessments for multiple destinations to analyse water-related risks, including drought, water scarcity, water quality, and other factors impacting tourism operations. My focus was on water-related risks regarding availability, access, and quality. I have chosen these risks based on a literature review, which is presented in chapter 2.

1.2. Problem Statement

In the past decades, a body of knowledge has developed on the interactions between water and tourism (Ricart et al., 2023). Research has been done on agenda-setting, such as identifying problems around tourism and water availability, and problem solving, such as aligning tourism with the United Nations' Sustainable Development Goals (SDGs) (Essex et al., 2004; Moyle et al., 2022; and Demeter et al., 2023). Gössling et al. (2012) and Garcia et al. (2022) covered the topic of tourism and water use from quantitative and qualitative viewpoints to assess the water demand of the sector. On the one hand, quantitative studies provide insights into tourism's impacts through water use, such as the daily consumption by tourists, consumption trends, and the effectiveness of water-saving technologies. On the other hand, qualitative studies highlight the necessity of shifting focus from technical solutions to incorporating behavioural and stakeholder perspectives in water management within tourism. However, many destinations lack comprehensive water risk assessments and effective risk mitigation strategies.

Stewardship programs are promoted as promising initiatives for environmental protection, despite being vaguely defined (Jones et al., 2015). The field of corporate water stewardship has been expanding, with global initiatives, guidelines, and tools that emphasize the role of businesses and their value chains in corporate water stewardship and water security (Sojamo & Rudebeck, 2024). However, there remains a research gap for corporate stewardship in the tourism industry. Water stewardship requires a fundamental shift in how companies perceive and manage water, recognizing it as a shared resource that extends beyond their direct operations to the catchment level (Hamilton, 2019).

The concept of water equity has gained prominence in water governance, underscoring the importance of fair access to water resources, especially for marginalized or underrepresented communities (Zwarteveen & Boelens, 2014; Jepson et al., 2017). Tourism development in water-scarce regions often worsens existing inequalities, where water use by hotels can come at the expense of local communities' needs (Cole, 2012; Becken, 2014). Despite the emphasis on efficiency and sustainability, many stewardship initiatives and water governance debates overlook distributive and procedural equity of who gets water, how decisions are made, and whose voices are heard (Gupta & Lebel, 2010). Embedding water equity into corporate stewardship strategies is essential for both social justice and long-term water resilience in tourism-dependent destinations.

1.3. Research Objectives

This thesis aims to provide a basis for the company to make informed decisions that support sustainable tourism practices from a destination management perspective including potential social and economic impacts. The company has the agenda to reduce freshwater use in their operations and engage in water stewardship actions across their value chain that addresses water scarcity and improve water-use efficiency. However, as of 2025, they have not yet implemented any formal water stewardship initiatives. As such, this thesis has two research objectives:

1. to identify tourist destinations of the company that are facing the highest water-related risks in order to prioritize areas which require urgent actions;
2. to assess location-specific risks and the principles of water stewardship while incorporating equity considerations to promote socially just and context-sensitive approaches to water management in tourism.

1.4. Research Questions

Main question: *How can a tourism company integrate water risk insights into their strategic planning to enhance sustainable water management in high-risk destinations?*

Three sub-questions are formulated towards answering the main question:

1. *From the worldwide hotel destinations that the company operates in, what are the main at-risk destinations that require urgent action?*
2. *What are the key water-related risks of the selected destinations that would affect the operations of the company?*
3. *To what extent is the Alliance for Water Stewardship (AWS) Standard suitable for guiding sustainable and equitable water management in tourism destinations facing high water risk?*

The sub-questions combine descriptive and evaluative approaches. The first sub-question is descriptive, identifying the most vulnerable destinations based on water-related risks, also relying on risk metrics from the World Resources Institute (WRI) Aqueduct Water Risk Atlas, which provides robust, peer-reviewed data on water risks globally, allowing for detailed spatial analysis and risk categorization (World Resources Institute, 2023). It links to the second sub-question, which aims to unpack the types and drivers of water-related risks that impact operations in the identified at-risk destinations. It incorporates data from the World Wide Fund for Nature (WWF) Water Risk Filter, which provides basin- and operational-level risk scores, focusing on indicators such as drought risk, water scarcity, and water quality. The analysis from the first and second sub-questions guides sub-question 3, which is evaluative. It involves assessing the AWS Standard through the lens of tourism context and water equity.

2. Literature Review

This chapter first introduces the concept of water risks in tourism, providing the definition of water risks and the specific context of these risks within the tourism industry. Subsequently, water risk assessments are introduced, describing and comparing the available tools that can be used for such purpose and their methodologies, followed by the introduction of water stewardship standards and principles. The chapter ends with the description of the "Physical, Reputational, and Regulatory Water Risk" (hereafter the PRR) as the conceptual framework.

I conducted the literature review to acquire a better understanding of the key ideas and concepts. With regards to section 2.1, the search was done through Scopus, using the string "water AND risks AND tourism AND industry". This search only covered scientific articles and book chapters. The second step focused on scoping, limiting the results to publications in English and excluding irrelevant subject areas. The search was also limited to relevant keywords, including tourism, risk assessment, water quality, water supply, water management, sustainable development, sustainability, tourism development, and tourist destination. Subsequently, the publications were selected by screening titles and abstracts, resulting in the full-text review of eight articles, in which the snowballing technique was applied to identify additional papers from the references. This review also included grey literature, such as reports and technical notes. The literature review on water assessment tools was based on the publications from the organizations that develop the tools in question. For section 2.3, the search was done through Scopus using two search strings: "water AND stewardship", and "corporate AND water AND stewardship". Both strings used the same refine search filters as the search for section 2.1, with the change of keywords limiting to water stewardship. Table 1 summarizes the results of the search strings and steps followed.

Table 1: *Search strings and steps followed on Scopus for peer-reviewed publications*

Seach Strings	Step 1 (Search)	Step 2 (Scope)	Step 3 (Screen)	Step 4 (Select)
water AND risks AND tourism AND industry	268	75	19	8
water AND stewardship	2,182	39	17	6
corporate AND water AND stewardship	73	15	8	2

2.1. Water Risks in Tourism

The risks that water imposes on a business have been long recognized by the business community. Understanding and appropriate responses to water risks are important steps that companies should follow to ensure preservation of shareholder value and respond to stakeholder concerns (Morgan et al., 2020). There have been efforts in framing the elements that make up freshwater issues. The SDGs outlined six targets under the SDG6 on water, including access to safe and affordable drinking water, access to adequate and equitable sanitation and hygiene, improve water quality, address water scarcity, implement integrated water resources management, and protect and restore water-related ecosystems (United Nations, n.d.). These sub-targets can be categorized into a set of issues to be considered when it comes to freshwater challenges, as seen in Table 2. This overview of the water challenges can be linked to a water risk framework that can impact businesses.

Table 2: *An overview of shared water challenges under SDG6*

Water Challenge	SDG 6 Targets
Water Availability and Access	6.1, 6.4
Water Quality and Pollution	6.3
Water Sanitation and Hygiene	6.2
Water-related Ecosystem Protection	6.6
Water Management and Governance	6.5

Source: Adapted from Morgan et al. (2020)

Water risk for businesses is commonly categorized into three interrelated types based on water-related challenges that can undermine business viability. These risk types are defined as follows (CEO Water Mandate, 2019):

1. Physical Risk: Having too little or too much water, water that is unfit for use, or inaccessible water;
2. Regulatory Risk: Changing, ineffective, or poorly implemented public water policy and/or regulations; and
3. Reputational Risk: Stakeholder perceptions that a company does not conduct business in a sustainable or responsible manner with regards to water.

Physical risks refer to materiality issues because of water-related events. They result from problems with water quantity and quality (Dumont-Bergeron & Gramlich, 2021). Regulatory risk is also referred to as "transition risk," which appears in the form of laws, policies, and regulations imposed by the government as means to regulate freshwater use and wastewater discharge (WWF, 2011; WWF Germany, 2019). Reputational risks arise when a company inadequately handles water resources, impacting both local communities and ecosystems (PRI & WWF, 2018). As a result, conflicts between the company's practices and community interests over water use may damage its reputation and affect the perceptions of stakeholders.

Another way of categorizing water risk for businesses is based on the source of the risk and the most appropriate mitigation response. Figure 1 illustrates this categorization by linking shared water challenges to water risks for businesses. The risk due to company operations, products, and services (operational risk) refers to the potential severity and probability of water-related challenges stemming from a company's activities, including its operations, products, and services. It also includes risks connected to suppliers and the ways their practices impact water availability, communities, and ecosystems. The risk due to basin context can be defined as potential severity and probability of water-related challenges that arise from the broader watershed or basin where a company and its suppliers operate. These risks are external to the company's direct operations and cannot be mitigated solely through internal changes (CEO Water Mandate, 2019).

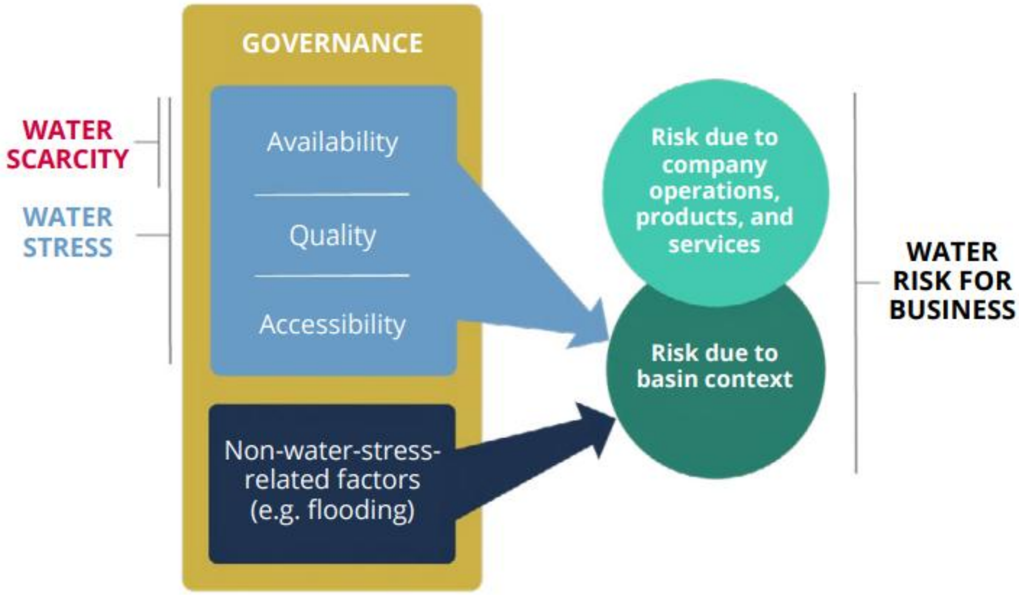

Figure 1*: The link between water challenges and water risks*
Source: CEO Water Mandate (2019:3)

Regarding the specific context of a tourism company, its water risks depend on the location where it operates. Some areas may be more vulnerable to water challenges than others, depending on geographical, socioeconomic and demographic factors. The Sustainable Hospitality Alliance conducted a water risk assessment on the hotel industry, reaching results that vary across regions. For example, some parts of China suffer from flooding and extreme weather, while some face water scarcity and high levels of pollution. Brazil, on the other hand, faces high seasonal water variability and flood events that cause water shortages, as well as coastal pollution (Sustainable Hospitality Alliance, 2013). When assessing the threats, impacts and risks for the industry, it is important to be site specific. While it is crucial to understand the wider water challenges, specific assessments are necessary to create suitable response strategies to the actual risks and conditions faced by the company where it operates (Sustainable Hospitality Alliance, 2013).

2.2. Water Equity and Tourism

The term 'equity' usually refers to fairness and impartial treatment, but also varies among the contexts (Mohanavelu & Osman, 2024). There are several definitions of water equity, but a widely used definition is 'equitable access to adequate water for all members of the population' (WHO & UNECE, 2019). In tourism-dependent regions, conflicts over water use often arise between tourism enterprises and local communities (Cole, 2012; Gössling et al, 2012). Tourism infrastructure is frequently concentrated in water-scarce coastal or island destinations, where it can exacerbate inequalities in water access and quality. While tourists often enjoy uninterrupted access to clean water, surrounding communities may experience intermittent supply or reduced quality (Tortella & Tirado, 2011). Cole (2012), for example, describes how excessive groundwater extraction by tourism businesses in Bali led to falling water tables and seawater intrusion, disproportionately affecting local households and farmers.

In a comparative study of per guest night water consumption, Becken (2014) analysed water use patterns across hotels and resorts globally. They found that the disparity between tourist and local water consumption was highest in developing regions, where tourists consume up to 956 L/night, which often far exceeds local access. In contrast, industrialized countries demonstrated more efficient water management with relatively balanced consumption between tourists and residents. These findings point to a growing need for destination-wide stewardship strategies that not only improve water efficiency but also integrate principles of equity, ensuring fair distribution and access for all users, particularly vulnerable communities.

In many water-scarce destinations, rising tourist volumes are related to the diminished local access and increased water prices. For example, in Ibiza, total natural freshwater capacity (~20.6 hm^3/year) is insufficient to meet combined local and tourist demand (~28 hm^3/year). Tourism alone requires about 2.9 hm^3/year, or 350 L/day per tourist, pushing desalinated water production to 7.6 hm^3/year with an estimated operating cost of €3.0 million/year. As a result, local households, who consume on average over 300 L/day, face strained supplies and may endure tariff increases or elevated prices, especially during peak season when desalination plants operate at full capacity (Pérez et al., 2020). Zhang and Tian (2021) found that international tourist activities in China between 2001 and 2018 accounted for an estimated 7.27 billion m^3 of freshwater use, with high pressures concentrated in already water-stressed provinces. They identified "double-high pressure" regions where both natural water scarcity and tourism-driven demand clash, creating competition between visitor consumption and local needs. Deyà-Tortella et al. (2016) analysed water consumption records from 134 hotels in Mallorca to assess how tariff structures influence demand. They found that water price elasticity in the hotel sector is extremely low. A 1% increase in price resulted in only a 0.024% reduction in consumption. Even on a water-scarce island, where seasonal demand peaks sharply, tourism establishments continued to consume high volumes of water with limited sensitivity to tariffs. This suggests that conventional price-based mechanisms do not effectively curb luxury water use in tourism and may fail to protect local supplies.

Addressing these imbalances requires moving beyond a technical or efficiency-driven approach to sustainable tourism. Scholars have emphasized the importance of incorporating justice-oriented frameworks into tourism research and practice. For instance, Lee and Jamal (2008) argue that an environmental justice lens to sustainable and ecotourism allows for a nuanced understanding of how tourism development can reinforce or mitigate inequalities. They draw attention to two key dimensions of justice: distributive justice, which concerns who receives what share of water resources, and procedural justice, which asks who is involved in the decision-making processes that govern water access. By including these justice considerations into water governance and tourism planning, the sector can move towards more inclusive and equitable outcomes.

2.3. Water Risk Assessment Tools

For several years, water has made the annual list that ranks the greatest risks to economies, the environment and people (World Economic Forum, 2015). In the World Economic Forum's Global Risks Report from 2020, the top five risks in terms of likelihood are all related to water (World Economic Forum, 2020). As such, companies thrive to understand and respond to these risks. In 2007, the World Business Council for Sustainable Development (WBCSD), followed by WRI in 2011 and WWF in 2012, independently created open-access tools to evaluate water status and associated risks (Morgan et al., 2020).

Several risk assessment tools have emerged that provide insights into water challenges for users. The three main leading water tools with the greatest market share are freely accessible and built on peer-reviewed data (Morgan et al., 2020). However, the WBCSD's Global Water Tool has been decommissioned and was taken offline in June 2019. The tool only covers the national level. As such, for the purpose of this study, only the WRI's Aqueduct Water Risk Atlas and WWF Water Risk Filter are discussed.

2.3.1. Aqueduct Water Risk Atlas

Launched in 2023, Aqueduct 4.0 is the latest iteration of WRI's water risk framework designed to convert complex hydrological data into intuitive indicators of water-related risk. It contains 13 baseline water risk indicators covering quantity, quality, and reputational concerns. Each indicator is gathered from an open-source, peer-reviewed data provider and then translated into a normalized risk score based on the severity of the water challenge (Kuzma et al., 2023). It includes future projections of water supply, demand, stress, depletion, and variability based on climate projections for three milestone years: 2030, 2050, and 2080 (Kuzma et al., 2023). Overall, it comprises of 13 indicators representing baseline annual water risks, three indicators representing baseline monthly water risks, and six indicators representing future projections of annual water risks (WRI, 2023). Aqueduct provides information on projected water risks based on optimistic, pessimistic, or business-as-usual climate and economic growth scenarios (Morgan et al., 2020).

The 13 indicators in Aqueduct were chosen based on literature review on relevant water issues, existing water indicators, and data source, evaluation of potential data sources through a comparative analysis of their spatial and temporal coverage, granularity, relevance to water users, consistency, and credibility of sources, and consultation with industry, public sector, and academic water experts (Kuzma et al., 2023). Table 3 illustrates the overview of the indicators.

Table 3: *Overview of the indicators in Aqueduct 4.0*

Risk category	Indicators
Physical quantity	Baseline water stress
	Baseline water depletion
	Interannual variability
	Seasonal variability
	Groundwater table decline
	Riverine flood risk
	Coastal flood
	Drought risk
Physical quality	Untreated connected wastewater
	Coastal eutrophication potential
Regulatory and reputational risk	Unimproved/no drinking water
	Unimproved/no sanitation
	Peak RepRisk country - ESG risk index

Source: Adapted from Kuzma et al. (2023)

Aqueduct also applies industry-specific weightings in their risk scores, containing six default industries with an option to customize the weightings. Each indicator of Aqueduct employs different sources and hydrological models to convert and calculate the raw data into risk categories. These data layers are categorized into three categories: physical, regulatory, and reputational. The overview of Aqueduct's data layers and their descriptions are presented in Appendix A.

2.3.2. Water Risk Filter

The Water Risk Filter is designed specifically for companies and businesses, providing a site-specific basin assessment, as well as an operational assessment based on the characteristics of the company's operation nature. The tool recommends assessing water risks across a company's value chain. As such, it provides default options to group sites according to Supply Chain Management (SCM) classification, starting from the stage of raw materials until the end of life. The tool follows a three-level hierarchy: 1) indicator, 2) risk category, 3) risk type It contains 42 global basin indicators and 12 risk categories. The basin risk assessment covers three list types: physical, regulatory, and reputational. The Water Risk Filter's 42 indicators are based on global datasets that assess water at the basin level. Each dataset uses its own method to calculate raw scores, which are then spatially aligned to river basins and translated into standardized risk scores ranging from 1 (very low risk) to 5 (very high risk). This translation involves normalizing diverse data types using indicator-specific thresholds, allowing for consistent comparison and aggregation across different indicators. Detailed methodologies are provided in the WWF WRF Indicator & Scenario Documentation (WWF, 2024a). Table 4 summarizes the three-level hierarchy of Water Risk Filter assessment framework.

Table 4: *Three-level hierarchy of the Water Risk Filter (basin risk)*

Risk Type	Risk Category	Indicator
PHY - PHYSICAL	BRC1 - Water Availability	B1_1 - Water Availability (SBTN)
		B1_2 - Baseline Water Stress
		B1_3 - Blue Water Scarcity
		B1_4 - Groundwater
	BRC2 - Drought	B2_1 - Drought Frequency Probability
		B2_2 - World Atlas of Desertification
	BRC3 - Flooding	B3_1 - Estimated Flood Occurrence
		B3_2 - Flood hazard
	BRC4 - Water Quality	B4_1 - Coastal Eutrophication Potential
		B4_2 - Nitrate-Nitrite Concentration
		B4_3 - Periphyton Growth Potential
		B4_4 - Toxicity Stress
		B4_5 - Mismanaged Plastic Waste
		B4_6 - Risk of pesticide pollution
		B4_7 - Total Dissolved Solids
		B4_8 - Surface Water Quality Index BOD
		B4_9 - Surface Water Quality Index Electrical Conductivity
	BRC5 - Ecosystem Services Status	B5_1 - Catchment Ecosystem Services Degradation Level
		B5_2 - Violation of Environmental Flows
		B5_3 - Wetland Degradation
		B5_4 - Invasive species
		B5_5 - River extent change
		B5_6 - Fragmentation Status of Rivers
BRG - REGULATORY	BRC6 - Enabling Environment - Policy & Laws	B6_1 - Freshwater Policy Status (SDG 6.5.1)
		B6_2 - Implementation Status of Water Management Plans (SDG 6.5.1)
	BRC7 - Institutions and Governance	B7_1 - Control of Corruption
		B7_2 - Private Sector Participation in Water Management (SDG 6.5.1)
	BRC8 - Management Instruments	B8_1 - Management Instruments for Water Management (SDG 6.5.1)
		B8_2 - Density of Runoff Monitoring Stations
	BRC9 - WASH Infrastructure	B9_1 - Access to Basic Safe Drinking Water
		B9_2 - Access to Basic Sanitation
BRP - REPUTATIONAL	BRC10 - Environmental factors	B10_1 - Freshwater Endemism
		B10_2 - Freshwater Biodiversity Richness
		B10_3 - RAMSAR wetlands
		B10_4 - Ecosystem Condition
		B10_5 - Free Flowing Rivers FFR
	BRC11 - Socioeconomic factors	B11_1 - Water Conflicts
		B11_2 - Labour/Human Rights
		B11_3 - Financial Inequality
	BRC12 - Additional reputational factors	B12_1 - Media scrutiny
		B12_2 - Risk Preparation
		B12_3 - Sites of international interest

Source: WWF (2024a)

The Water Risk Filter's regulatory risk layer is closely connected to the idea of good governance, emphasizing that businesses prosper within a stable, efficient, and well-enforced regulatory framework. It aligns with the SDG 6.5.1 framework and includes four categories of risk: enabling environment, institutions and governance, management instruments, and Water, Sanitation, and Hygiene (WASH) infrastructure (WWF, 2024b).

Aggregated risk scores are calculated by applying industry-specific weightings, with the total of 26 industry categories, which are based on a list of multiple standard industry classifications. Both basin and operational assessments apply industry-specific weightings that reflect how different industries interact with water resources in different ways. As such, the overall risk score will be based on adjusted weights assigned to different risk indicators. The filter also includes future projections for 2030 and 2050 (WWF, 2024). Each indicator of the Water Risk Filter uses different sources and hydrological models to convert and calculate the raw data into risk categories. The overview of the data layers is presented in Appendix B. The Water Risk Filter displays results by giving risk scores. The risk score classification is consistent throughout all indicators, risk categories, and risk types. Figure 2 shows the five risk scores of the Water Risk Filter.

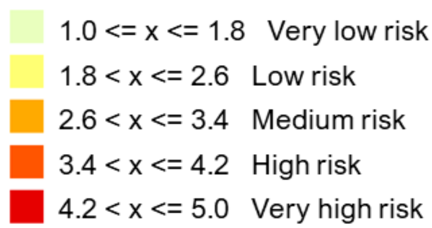

Figure 2: *Risk score classification of the Water Risk Filter*
Source: WWF (2024a:9)

Physical risks refer to both natural and human-induced conditions of river basins and encompass water availability, drought, flooding, water quality, and the status of ecosystem services. essentially addressing whether water is too scarce, too abundant, unfit for use, or compromised by degraded ecosystems (WWF, 2024a). Broader physical water risks experienced across the countries, while also highlighting local variations in risk exposure.

Regulatory risk layer is closely connected to the idea of good governance, emphasizing that businesses prosper within a stable, efficient, and well-enforced regulatory framework. It aligns with the SDG Target 6.5 and includes four categories of risk: enabling environment, institutions and governance, management instruments, and WASH infrastructure (WWF, 2024b).

Reputational water risks arise from actual or perceived negative social and environmental consequences of how producers use water. Such reputational water risks can have long-lasting effects on companies, even in the absence of legal action or actual environmental damage (Hepworth & Orr, 2013). The reputational risk layer of the Water Risk Filter reflects how stakeholders and local communities perceive a company's sustainability and responsibility in managing water resources. Negative perceptions can harm a company’s brand, reduce market share, and impact overall business performance. This layer is divided into three main risk categories: environmental factors, socioeconomic factors, and other reputational considerations. (WWF, 2024b). Unlike other risk layers, reputational risk encompasses multiple dimensions rather than focusing solely on social or environmental aspects. Environmental factors address local environmental assets and the local prevalence of freshwater biodiversity-related issues, while socioeconomic factors cover local socioeconomic conditions and the local prevalence of socioeconomic issues. Furthermore, the degree of public scrutiny that businesses face in a particular area also contributes to their reputational risk.

In addition to the basin risk assessment, the Water Risk Filter also provides insights on operational risk assessment, following the same three level hierarchy. The operational risk is assessed by filling in the Water Risk Filter Operational Risk Questionnaire, which contains 22 questions (i.e. indicators) for the detailed assessment questionnaire, while rapid assessment questionnaire consists of only 10 questions. In this regard, it must be noted that the additional questions in the detailed assessment do not affect the risk score, but allow a better understanding and assessment of operational risks (WWF, 2024a).

The operational risk assessment is based on the same aggregation principles and risk score classification as the basin risk assessment, as well as the application of industry-specific weightings. Table 5 shows the overview of the indicators and the three-level hierarchy framework.

Each question in the operational questionnaire offers five response options, corresponding to risk scores on a scale of 1 to 5. These scores are then consolidated into six operational risk categories, which are further grouped into three overarching risk types:

- Physical risk assessment consists of water scarcity and water quality indicators. Scores are derived from a set of questions that examine the nature of water consumption at the site, the criticality of water to operational processes, the need for water treatment, and the facility's potential to impact downstream water quality.
- Regulatory risk assessment consists of enabling environment and institutions and governance indicators. Scores are derived from a set of questions that examine the regulatory scrutiny facing the site and quality standards compliance.
- Reputational risk assessment consists of conflict indicators. Scores are derived from a set of questions that examine the relative water use of the site within the basin, local brand recognition, and water stewardship maturity.

Table 5: *Three-level hierarchy of the Water Risk Filter Framework (operational risk)*

Risk Type		Risk Category	Risk Indicator
PHY - PHYSICAL	ORC1 - Water Scarcity	Yes	O1 - Form of water consumption
		Yes	O2 - Importance of water in operations
			O3 - Historical issues with shared water challenges
			O4 - Total water withdrawn (approximate)
			O4a - Specific water withdrawal
			O4b - Fresh surface water withdrawal
			O4c - Brackish surface water withdrawal
			O4d - Groundwater withdrawal
			O4e - Seawater / ocean water withdrawal
			O4f - Produced / processed water withdrawal
			O4g - Third-party water withdrawal
			O5 - Total water discharged (approximate)
			O5a - Specific water discharge
			O5b - Discharge to fresh surface water
			O5c - Discharge to brackish water
			O5d - Discharge to groundwater
			O5e - Discharge to seawater/ocean water
			O5f - Discharge to long term storage
			O5g - Discharge to third-party
			O6 - Water-intensive energy source dependence
	ORC3 - Water Quality		O7 - Total wastewater discharged into environment
			O7a - Amount of Nitrogen discharged
			O7b - Amount of Phosphorus discharged
		Yes	O8 - Treatment requirements - before use
		Yes	O9 - Treatment requirements - prior to discharge
			O10 - Toxic chemicals used or stored on site
		Yes	O11 - Ability to impact downstream water quality
BRG - REGULATORY	ORC5 - Enabling	Yes	O12 - Regulatory scrutiny facing site
			O13 - Planned regulatory changes
	ORC6 - Institutions & governance	Yes	O14 - Quality standards compliance
			O15 - Historical penalties or fines
			O15a - Amount of fines/penalties
			O16 - Presence and participation in basin stakeholder water
BRP - REPUTATIONAL	ORC11 - Media Scrutiny		O17 - Local media exposure
			O18 - Global media exposure
	ORC12 - Conflict	Yes	O19 - Relative water use of site within basin (User/Polluter)
		Yes	O20 - Local brand recognition
		Yes	O21 - Water stewardship maturity
			O22 - Involvement in water disputes with others
Other			O23 - Annual production volume
			O24 - Production unit
			O25 - Approximate production value
			O25a - Specific production value
			O26 - Currency
			O27- Number of employees
			O28 - Comments

Source: WWF (2024a)

2.3.3. Comparison of the Available Tools

Both the Aqueduct and the Water Risk Filter share the same fundamental purpose: providing a standardized approach to assessing water risk on a global scale. One of the largest differences between (and combined strength of) the tools concern their respective data sources and scope of water data coverage (Morgan et al., 2020). However, a key difference is the operational risk that is assessed in Water Risk Filter, but not in Aqueduct. Both consider the three categories of risks: physical, regulatory, and reputational. However, certain functions in Water Risk Filter allow companies to obtain more comprehensive insights in their operations. For example, users can choose to analyse the risks for companies and businesses, in which the website allows for a bulk upload of data. The data displayed for this matter is shown as the number of sites and their aggregated risk scores. On the other hand, users can also analyse water risk on a site-specific approach. The site will provide data on the risk scores which are on a single site basis. As such, Water Risk Filter is more intended for company use. However, both tools are suitable for different purposes. Aqueduct is more suitable for users who aim to view broad-scale water stress and climate risk data. Table 6 summarizes the main differences and similarities between the tools.

Table 6*: Comparison of Aqueduct and Water Risk Filter*

Aspect	**Aqueduct**	**Water Risk Filter**
Basin/ Operational	Basin	Basin & Operational
Number of indicators for Basin Risk Assessment	Physical (10), Regulatory & Reputational (3)	Physical (23), Regulatory (8) & Reputational (11)
Spatial Resolution at Bain Scale	HydroSHEDS HydroBASINS Level 6	HydroSHEDS HydroBASINS Level 7
Temporal Scope	Past/Average, Present/Recent, Future	Past/Average, Present/Recent, Future
Industry risk weightings	Yes – Adjustable	Yes – Adjustable

Source: *Adapted from Morgan et al. (2020)*

Given the strengths of both tools, this thesis will utilize both Aqueduct and Water Risk Filter in the assessment complementarily. In this sense, Aqueduct offers global, large-scale data and quantitative metrics that allow for an easy, high-level comparison of water risk across various regions. Several organizations and companies have utilized the Aqueduct Water Risk Atlas to assess water-related risks, leveraging its quantitative data and global coverage to inform decision-making. For example, Coca-Cola has used the Aqueduct tool to assess water stress across its global supply chain and identify regions with high water scarcity risks and prioritize water stewardship efforts in areas where they are most needed. Nestlé applied Aqueduct to analyse water risks in its operations in various countries, helping the company manage water resources more sustainably and address environmental and operational challenges linked to water scarcity (World Resources Institute, n.d.). Aqueduct has proven to be a strategic tool for identifying and evaluating water risks on a global scale, especially in industries reliant on significant water resources.

Aqueduct also offers a more global, standardized perspective on water risk, based on historical hydrological data, which is useful in identifying destinations that are under significant water stress or at risk of future water scarcity, even before considering other contextual factors (e.g., regulatory or reputational risks). Using Aqueduct can quickly filter out destinations with low to medium water risk, excluding those that do not need further evaluation for water issues. On the other hand, Water Risk Filter offers a more qualitative and business-oriented perspective, providing a deep dive into specific, localized risks, which serves the objective of this thesis to assess water risks for a tourism company. In this sense, it covers business-relevant risks through the operational assessment, as well as providing a wider range of industry-specific weightings, including the hospitality industry, which is not applicable on Aqueduct. It also groups sites according to SCM classification, which allows companies to assess water risks across their supply chain.

In conclusion, filtering destinations using Aqueduct will allow the most water-vulnerable ones to be assessed with Water Risk Filter. Narrowing down priority areas will, in turn, make Water Risk Filter's deeper analysis more efficient.

2.4. Water Stewardship

Water stewardship is the use of water that is socially and culturally equitable, environmentally sustainable, and economically beneficial, achieved through a stakeholder-inclusive process that includes both site- and catchment-based actions (AWS, 2022). Water stewardship is founded on the idea that the sustainable management of shared water resources can be improved through transparent and inclusive engagement with its users. It is essential for water users to understand the source of their water and recognize how their own consumption, along with that of others, affects the availability and quality of the water on which they depend on (Sym & Wade, 2021).

Water assessment tools can be used to help these users understand the complexity of water availability and their consumption. Companies may adopt these tools to assess current and possible future water conditions in areas of operations. For example, EDEKA, a leading German food retailer, has used Water Risk Filter to assess water risks in the initial stages of establishing a water stewardship framework (Laporte-Bisquit, 2021).

2.4.1. The AWS Standard

AWS is a global, multi-stakeholder membership-based organization, with the aim to ignite and nurture global and local leadership in credible water stewardship that recognizes and secures the social, cultural, environmental and economic values of freshwater through global membership and the AWS Standard (AWS, 2019). AWS is the first globally recognized standard for sustainable and resilient water use. This certification enables companies to minimize their water footprint by fostering external collaboration and cooperative efforts between various stakeholders. As a result, issues are tackled not only within the site's physical boundaries but also in the broader catchment area through an inclusive, stakeholder-driven process (Bizzaro et al., 2023).

The AWS Standard follows a structured five-step approach that guides users through assessing water-related risks and opportunities, followed by taking action (as shown in Figure 3). This process is designed as a continuous cycle of impact evaluation and improvement, with transparency being reinforced through communication and disclosure. Each step contains specific criteria with corresponding indicators that must be met to comply with the Standard. Additionally, some indicators are classified as 'advanced indicators,' encouraging sites to go beyond the core certification requirements. Sites that accumulate sufficient points from these advanced indicators may achieve gold or platinum certification (Sym & Wade, 2021; AWS, 2019).

Figure 3: *AWS Standard and the outcomes*
Source: AWS (2019:6)

The AWS Standard aims to contribute to five key outcomes: 1) Good water governance, 2) A sustainable water balance, 3) Good water quality status, 4) Protection of Important Water-Related Areas (IWRAs), 5) Access to WASH for all. Each step of the AWS Standard supports one or more of these five outcomes. To assist with implementation, comprehensive guidance is provided throughout the process. The AWS Standard is designed to adapt to the specific context of each site and its surrounding catchment, making it applicable to any water user worldwide. Through certification, sites can demonstrate credible and verifiable water stewardship performance, supported by independent third-party verification (Sym & Wade, 2021; Bizzaro et al., 2023).

The AWS Standard has also been applied together with water risk assessment tools. Many companies use the Water Risk Filter, the Aqueduct, or a combination of the two to gather data on current practices, and to map operations and supply chains before implementing the Standard (Sym & Wade, 2021).

2.4.2. Corporate Water Stewardship

Corporate water stewardship is the progressive result of a diverse range of developments (Sojamo & Rudebeck, 2024). This concept is rooted in the idea of water footprints (Hepworth & Orr, 2013; Rudebeck, 2019), which companies and businesses subsequently realized their roles in water consumption and as corporate water users. As such, this brought the concept of corporate water stewardship as the notion of the necessity of managing 'shared water risks' for business and society via collective action (Orr et al., 2009; CEO Water Mandate, 2010).

There have been several initiatives by companies around the world in implementing water stewardship. For example, Ingham's, Australia's largest integrated poultry producer and a major water user, has demonstrated the versatility of the AWS Standard with its applicability not only to large water users but also to smaller stakeholders (Sym & Wade, 2021). WWF supports businesses in their water stewardship efforts, partnering with companies to assess and mitigate water risks. Since 2009, they have collaborated with SABMiller to evaluate water risks in countries like Tanzania, Peru, South Africa, and Honduras, leading to targeted risk mitigation projects. Marks & Spencer utilized the Water Risk Filter to analyse risks in the food supply chain and provided guidance on water stewardship strategies (WWF UK. n.d.).

2.5. Conceptual Framework

Aqueduct and the Water Risk Filter were designed as "water risk" tools and intended to convert raw data into categorized risk types. The water risk frameworks used in both tools employ a similar foundation as depicted Figure 4 and described by the UN Global Compact's CEO Water Mandate. This PRR framework has become a widely recognized and accepted approach within corporate water stewardship practices.

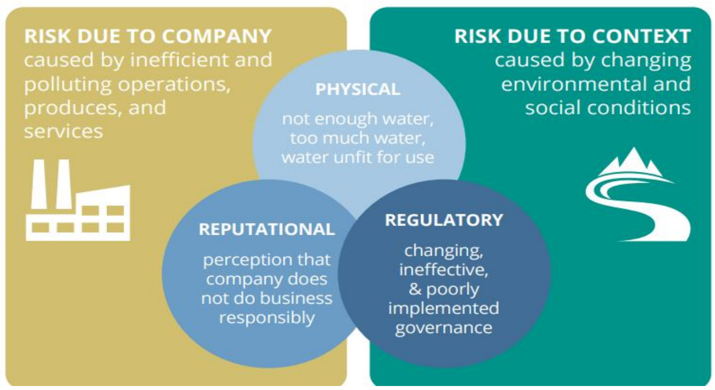

Figure 4: *Water Risk Framework*
Source: CEO Water Mandate (n.d.)

Several studies have adopted these three risks in their water assessments. McCall et al. (2021) examine the critical role of water in manufacturing and the associated water risks. Josset & Larrauri (2021) explore how corporations and the financial community address water-related risks as. Lanari & Bek (2022) apply the PRR framework to examine how various water risks manifest within agricultural value chains.

I employed the PRR framework in water risk assessment to provide a structured approach for understanding water-related challenges. As described in sections 2.2.2 and 2.2.3, this framework is also adopted by the main tools that will be used in this study, Aqueduct and Water Risk Filter. Their risk categories are physical, regulatory, and reputation. I used the framework in identifying risks to inform water stewardship strategies and propose risk mitigation actions tailored to each risk type.

3. Research Design

This chapter starts with an overview of the methodology. It then details the data needs and sources to answer the research questions, followed by a description of the data collection process. The chapter then explains the data analysis methods. Finally, ethical considerations are addressed to ensure integrity and fairness of the research.

3.1. Overall Methodology

I employed a combination of quantitative and qualitative approaches. The initial focus is on utilizing quantitative tools, the Water Risk Filter and Aqueduct, to evaluate the water risks faced by various tourist destinations. This approach allows measuring water stress, variability, and future projections. The qualitative insights gathered from desk research and expert interviews help contextualize the quantitative results by covering regulatory, reputational, and operational risks that may not be fully represented in numerical models. The PRR framework forms a conceptual framework for this research, being used in assessing the destinations and the associated water risk, to identify key high-risk destinations that must be further evaluated.

Regarding the initial assessment on Aqueduct, I adopted the same approach as the Destination Water Risk Index (DWRI), which focuses on physical, financial, and market risks (Sustainable Hospitality Alliance, 2023). The DWRI emphasizes destinations with very high water-related risks, such as Delhi (India), Maldives, and Xian (China), which require prioritized action to address current and future local water scarcity. This prioritization suggests that severe physical water risks can overshadow other considerations, potentially making further assessments of reputational or regulatory risks secondary in these contexts.

Gössling et al. (2012) discuss how tourism's dependence on freshwater resources means that changes in water quantity or quality can have detrimental impacts on tourism. The study concludes that destinations already experiencing water stress should engage in proactive water management to ensure sustainability. This implies that without addressing severe physical water scarcity, other risk assessments may be of limited relevance (Gössling et al., 2012). As such, the methodology employed the initial assessment on Aqueduct had the primary focus on physical water risks on the initial stage.

In the subsequent evaluation of the AWS Standard's suitability for high water risk tourism destinations, I reviewed research that critically examines how the AWS Standard or similar water stewardship principles has been applied in diverse contexts by drawing on case studies, AWS Standard guidance documents, and scholarly analyses. This desk-research complements the quantitative risk screening by linking theoretical water stewardship principles to practical evidence on governance challenges, power dynamics, and local contextual fit.

3.2. Data Set

The purpose of this section is to clarify the data set used in the water risk assessment on Aqueduct, specifically in relation to the destinations where the company operates hotels, The data set refers to the destinations for inclusion in the water risk assessment on Aqueduct are based on the list of the hotel destinations that the company operates in. A total of 361 destinations across 37 countries are included. All destinations will be included into the Aqueduct assessment, using the bulk data upload feature within the tool. Table 7 summarizes the data set of the destinations

Table 7: *Data set of the destinations*

Americas		Europe		Africa		Asia	
Country	Destination	Country	Destination	Country	Destination	Country	Destination
Antigua	2	Austria	6	Cape Verde	7	China	3
Aruba	2	Croatia	3	Egypt	49	Cyprus	19
Bahamas	1	Germany	3	Morocco	10	Malaysia	1
Costa Rica	3	Greece	32	Senegal	1	Maldives	4
Cuba	13	Ireland	1	Tanzania	4	Mauritius	2
Dominican Republic	11	Italy	3	Tunisia	13	Sri Lanka	1
Grenada	1	Portugal	3			Thailand	1
Jamaica	12	Spain	78			Turkey	27
Mexico	30	United Kingdom	1			United Arab Emirates	2
Panama	2					Vietnam	3
Saint Lucia	2						
United States	5						

3.3. Data Collection, Needs, and Sources

The data needs and sources vary per sub-question. Each sub-question is answered through different methods where different data will be collected. Table 8 summarizes the data needs, sources and collection methods per question.

Table 8: *Data needs, sources and collection methods*

Question	Data Needs	Data Sources	Data Collection Methods
RQ1	Baseline water stress, seasonal variability, and future water stress scores in each destination	World Resources Institute's Aqueduct Water Atlas 4.0	Identify high-risk destinations using Aqueduct Narrow down the sample to five destinations based on the severity of water risks
RQ2	The Water Risk Filter assessment data, both basin and operational assessments, destination country risks and barriers, such as regulatory, social, technological barriers	The Water Risk Filter, Open access data, Scientific articles, News Articles, Country Reports, UN-Water SDG 6 Data Portal, and Water Conflict Chronology	Using the destinations identified from RQ1, identify the key risks under the PRR framework using the Water Risk Filter Conduct interviews within the company regarding the operational assessment (see Appendix C for the risk hierarchy) Conduct desk research on the physical, regulatory, and reputational risks of the destination countries
RQ3	AWS Standard core criteria and guidance documents, case studies on corporate water stewardship initiatives	AWS documentation (Standard and guidance), Open access data, Scientific articles, Industry reports from tourism/hospitality sector	Conduct a document analysis of the AWS Standard and related implementation materials

The chosen risk metrics on Aqueduct follow the same approach as the DWRI. The DWRI is intended for hotel companies to prioritize action on water scarcity in risk destinations and implement water stewardship strategies in their hotel developments and operation (Sustainable Hospitality Alliance, 2023). The risk metrics that were assessed were Baseline Water Stress (BWS), Seasonal Variability (SEV), and Future Water Stress (BAU30).

BWS refers to the ratio of total water demands to available renewable surface and groundwater supplies. Higher values indicate more competition among users. SEV refers to the average within-year variability of available water supply, including both renewable surface and groundwater supplies. Higher values indicate wider variations of available supply within a year. BAU30 refers to an indicator of competition for water resources and is defined as the ratio of demand (withdrawal) divided by availability (supply).

3.4. Data Analysis

I applied a combination of quantitative and qualitative methods for data analysis. As shown in Table 9, the data analysis consists of three steps. First, I used Aqueduct to screen destinations based on BWS, SEV, and BAU30, allowing for an initial selection of high-risk locations. This step utilizes the function on Aqueduct that allows bulk upload of the data of location names and their addresses. After that, I downloaded the data to Excel, where I filtered the data to focus on the risk scores of the three criteria. The I ranked the destinations based on a composite risk score derived from the three water indicators. From this ranking, I generated a list of five destinations with the highest combined water-related risks. These locations form the basis for the subsequent qualitative and operational risk assessment in the second step.

Table 9*: Data analysis and intended outputs*

Step	Action	Intended Outputs
Step 1: Destination Pre-Selection	Screen the destinations using Aqueduct. The main criteria are baseline water stress, seasonal variability, and future water stress (future projection of the year 2030)	Five scenarios (see Table 10 for further details on the scenario outcomes and criteria).
Step 2: Water Risk Classification	Assess risks in shortlisted destinations under the PRR framework using the Water Risk Filter. Utilize industry-specific weighting, selecting the option for hospitality industry. Conduct desk research on each destination to identify the key risks in each site	Three-level hierarchy water risks and a deeper contextual understanding of water risks
Step 3: Water Stewardship Analysis	Assess the suitability of the AWS Standard for guiding sustainable and equitable water management in high water risk tourism destinations	Identification of strengths, limitations, and gaps in the AWS Standard

For Step 1, the combination of the metrics results in different risk scenarios, each requiring a decision on whether to include a destination for further analysis. Then, to determine how these metrics should be combined into distinct risk scenarios, I conducted a literature review on case studies that assess water-related risks. The aim of the review is to identify which combinations of risks necessitate further action and which may not require additional analysis.

The first scenario is where there is a high risk across all metrics. Liu et al. (2024) found that the North Slope of the Tianshan Mountains show that the baseline water stress is high due to the growing ecological footprint combined with the high seasonal variability because of inconsistent rainfall. The current water stress is likely to worsen, which would lead to an expected 17%-34% water scarcity. In the future this problem will be worsened while also experiencing potential water scarcity due to climate change. These findings highlight the urgent need for comprehensive water management strategies.

The second scenario focuses on areas with relatively high current water stress and seasonal variability, as well as high projected water stress in the future. Coffel et al. (2019) found that in the Nile basin, dry years have become more frequent in the 2010, and this trend is likely to continue. The current water stress is already quite high, but an additional 5-15% of the future population facing water scarcity is expected. The study concludes that climate-resilient water management policies informed by an understanding of compound extremes will be essential to manage these risks.

The third scenario focuses on areas with moderate to high current water stress and high future water stress. Milano et al. (2015) found that in western Switzerland, moderate water stress is seen during the summer months. By 2060, water needs could exceed 80% of the rivers' available resources in low- to mid-altitude environments in mid-summer, as an effect of drier and warmer climate. This study shows the importance of setting up regional mitigation strategies. Focusing on water stress, Suárez-Almiñana et al. (2020) found that the Júcar River basin in Spain is highly susceptible to water scarcity, with projections indicating a significant decrease in natural inflows and a high probability of the water resource system operating below 50% capacity in the near future. As such, the study calls for water planning and management analysis in areas with high water stress.

The fourth scenario focuses on areas with high current seasonal variability. Eldardiry et al. (2020) found that addressing variability in the analysis of water systems will be critical for a successful management of water resources. Researching seasonal variability is important to make a strategy where no water is wasted, but also where not enough water is available. Future water seasonality is not included in the metrics. In many regions, seasonal climate forecasts have limited skill, making reliable predictions of future seasonal variability difficult (Jackson-Blake et al., 2022). Given the uncertainty, incorporating future seasonal variability into risk assessments may not provide reliable insights, potentially leading to misguided strategies.

The levels for BWS, SEV, and BAU30 were determined based on the risk categories and corresponding score ranges used within Aqueduct. Aqueduct categorizes water risk on a standardized scale, assigning thresholds to different levels of severity (Kuzma et al., 2023). For example, BWS is classified as Low (<10%), Medium-High (20-40%), High (40-80%), and Extremely High (>80%), providing a clear framework for assessing water availability relative to demand. Similarly, SEV follows a scale from Low (<0.33) to Extremely High (>1.33), indicating the degree of fluctuation in water supply over the course of a year. These predefined categories were directly applied in the scenario development to maintain consistency with established methodologies and ensure that risk assessments align with widely recognized scientific benchmarks. Table 10 summarizes the scenario outcomes and selection criteria for Step 1.

Table 10: *Aqueduct screening outputs and selection criteria*

Scenario	BWS	SEV	BAU30	Inclusion in further analysis
1. High Risk Across All Metrics	High (40-80%) to Extremely High (>80%)	High (1.00-1.33) to Extremely High (>1.33)	High (40-80%) to Extremely High (>80%)	Yes
2. High Current Risk, Worsening in the Future	High (40-80%) to Extremely High (>80%)	Medium-High (0.66-1.00) to High (1.00-1.33)	High (40-80%) to Extremely High (>80%)	Yes
3. Moderate Current Water Stress, High Future Risk	Medium-High (20-40%) to Extremely High (>80%)	-	High (40-80%) to Extremely High (>80%)	Yes
4. High Seasonal Variability	-	High (1.00-1.33) to Extremely High (>1.33)	-	Yes
5. Low Overall Risk	Low (<10%)	Low (<0.33)	Low (<10%)	No

Source: Adapted from Sustainable Hospitality Alliance (2023)

For Step 2, the data from the WWF platform was supplemented by desk research into national and regional water governance structures, regulatory environments, and potential social and technological constraints that may hinder effective water management in tourism operations. I used the results from the Water Risk Filter, including both basin and operational assessments, applying the traffic light colour coding based on WWF's risk classification system. All scores presented are taken directly from WWF's analysis and reflect their established calculation methods, which include sector-specific weighting and indicator-specific risk scoring.

Since the regulatory risks on the Water Risk Filter are more of a systemic issue than location-specific, the scores in the risk categories are not driven by isolated local events or characteristics, but rather by broader, shared national or sector-wide factors. This resulted in similar scores throughout the country, as the sub-indicators within these categories rely on national-scale data such as laws and policies, national integrated water resources management (IWRM) plans, and control of corruption within the country. As such, most analyses may be on a broader national level. Thus, I also included data from the UN-Water SDG 6 Portal, particularly the country report on SDG 6.5.1 to provide insight into each country's progress on IWRM and its implications for regulatory water risks. The portal offers more granular, country-specific information, which helps contextualize the broader risk categories within national governance and water management systems. Complementing with other indicators on the Water Risk Filter (see Appendix B for the details of the data layers and indicators summary), this allows for a more comprehensive assessment of regulatory risks by integrating both global frameworks and localized conditions

Additionally, a conversational interview was conducted with a professional in the company. The interview aims to refine the operational risk assessment, particularly in terms of site-level practices, dependency on local water sources, and awareness of corporate water responsibility. The operational assessment is done through a rapid questionnaire, where the full list of questions can be found in Appendix D. The questionnaire consists of 10 questions, covering three risk types: physical, regulatory, and reputational.

Step 3 involves a literature-based analysis of how tourism businesses manage water-related risks and whether their practices align the AWS Standard. I analysed case studies from leading hotel chains, travel companies, and sustainable tourism initiatives and focus on how companies manage water scarcity, implement conservation technologies, and engage with local communities and policymakers to achieve sustainable and equitable water management. I also paid attention to strategies that align with the AWS Standard and the indicators.

3.5. Ethical Considerations

This research adheres to the ethical standards provided by the University of Twente. An ethics assessment was conducted before starting the data collection through interviews. The participant involved in the interview was fully informed beforehand about the purpose of the research, the methods used, and the nature of their involvement. They were provided with the consent form to receive their written or oral approval. To maintain the privacy of the participant, all personal information shared during the interview was kept confidential. Any identifying information were anonymized in the reporting and dissemination of results to prevent the identification of individual participants or organizations. All data collected, both quantitative and qualitative, were analysed objectively. The data from the Water Risk Filter, Aqueduct, and the interviews were reported accurately, and the findings will be used to inform the development of practical, actionable recommendations. Any potential conflicts of interest or biases will be disclosed and addressed.

4. Results

This chapter presents the findings based on the multi-step water risk assessment conducted across the company's global portfolio of hotel destinations. The analysis addresses the sub-questions by first identifying the most water-stressed and operationally significant locations, then examining the specific water-related risks affecting those sites and finally proposing tailored mitigation strategies and stewardship actions.

4.1. Identification of High-risk Destinations

This section answers the first sub-question using Aqueduct as the main tool. A total of 360 hotel locations worldwide were assessed using the Aqueduct. Key indicators such as BWS, SEV, and BAU30 were analyzed. Each location was assigned a qualitative risk label based on Aqueduct thresholds. As elaborated in section 3.4, the outputs from Aqueduct may be separated into five scenarios.

4.1.1. High Risk Across All Metrics

This scenario focuses on locations that face high (40-80%) to extremely high (>80%) BWS, high (1.00-1.33) to extremely high (>1.33) SEV, and high (40-80%) to extremely high (>80%) BAU30. Based on the outputs from Aqueduct, the countries selected under this scenario were Egypt and Mexico, with extremely high (>80%)BWS, high (1.00-1.33) SEV, and extremely high (>80%) BAU30. There were one and three hotels flagged in Egypt and Mexico, respectively.

4.1.2. High Current Risk, Worsening in the Future

The second screening scenario focuses on destinations exhibiting high current water risk, particularly in BWS, coupled with worsening future stress projections, i.e., locations that face high (40-80%) to extremely high (>80%) BWS, medium-high (0.66-1.00) to high (1.00-1.33) SEV, and high (40-80%) to extremely high (>80%) BAU30. Based on the outputs from Aqueduct, 11 locations were identified. The countries selected under this scenario were Egypt, Italy, Mexico and Spain. Table 11 summarizes the findings of this scenario.

Table 11*: Overview of the locations with high current risk, worsening in the future*

Country	BWS	SEV	BAU30	Number of hotels
Egypt	Extremely High (>80%)	High (1.00-1.33)	Extremely High (>80%)	1
	Extremely High (>80%)	Medium - High (0.66-1.00)	Extremely High (>80%)	3
Italy	Extremely High (>80%)	Medium - High (0.66-1.00)	Extremely High (>80%)	1
Mexico	Extremely High (>80%)	High (1.00-1.33)	Extremely High (>80%)	3
	High (40-80%)	Medium - High (0.66-1.00)	High (40-80%)	2
Spain	Extremely High (>80%)	Medium - High (0.66-1.00)	Extremely High (>80%)	1
Total				**11**

4.1.3. Moderate Current Water Stress, High Future Risk

The third scenario focuses on destinations exhibiting moderate to high current water stress, coupled with future high water stress projections, i.e., locations that face medium-high (20-40%) to extremely high (>80%) BWS, and high (40-80%) to extremely high (>80%) BAU30. Based on the outputs from Aqueduct, 169 locations were identified. The countries selected under this scenario were Cyprus, Egypt, Germany, Greece, Italy, Mexico, Morocco, Portugal, Spain, Tunisia, Turkey, United Arab Emirates, United Kingdom and United States. Table 12 summarizes the findings of this scenario.

Table 12: *Overview of the locations with moderate current water stress, high future risk*

Country	BWS	BAU30	Number of hotels
Cyprus	Extremely High (>80%)	Extremely High (>80%)	19
Egypt	Extremely High (>80%)	Extremely High (>80%)	6
Germany	High (40-80%)	High (40-80%)	1
Greece	Extremely High (>80%)	Extremely High (>80%)	32
Italy	Extremely High (>80%)	Extremely High (>80%)	3
Mexico	Extremely High (>80%)	Extremely High (>80%)	3
	High (40-80%)	High (40-80%)	2
Morocco	Extremely High (>80%)	Extremely High (>80%)	5
Portugal	Extremely High (>80%)	Extremely High (>80%)	2
Spain	Extremely High (>80%)	Extremely High (>80%)	53
Tunisia	Extremely High (>80%)	Extremely High (>80%)	7
	High (40-80%)	High (40-80%)	3
	Medium - High (20-40%)	High (40-80%)	1
Turkey	Extremely High (>80%)	Extremely High (>80%)	1
	High (40-80%)	Extremely High (>80%)	3
	High (40-80%)	High (40-80%)	23
United Arab Emirates	Extremely High (>80%)	Extremely High (>80%)	2
United Kingdom	High (40-80%)	High (40-80%)	1
United States	High (40-80%)	High (40-80%)	2
Total			**169**

4.1.4. High Seasonal Variability

The third scenario focuses on destinations exhibiting high current seasonal variability, i.e., locations that face high (1.00-1.33) to extremely high (>1.33) SEV. Based on the outputs from Aqueduct, seven locations were identified, with one location in Egypt and six locations in Mexico.

4.1.5. Low Overall Risk

The last scenario focuses on destinations exhibiting low risk across all metrics, i.e., locations that face low (<10%) BWS, low (<0.33) SEV, and low (<10%). Based on the outputs from Aqueduct, seven locations were identified. The countries selected under this scenario were Antigua, Austria, Croatia, and Malaysia. This scenario is excluded from further analysis due to its limited relevance to the overarching objective of assessing and managing water-related vulnerabilities in high-risk regions.

According to Wang (2024), water risk assessments are most critical in regions experiencing elevated stress or undergoing rapid hydrological changes. In contrast, low-risk areas, while important in water governance, typically do not demand the same level of urgent intervention or adaptation planning, as policy and resource efforts are best directed toward regions facing acute or escalating water challenges (OECD, 2013). Including such regions could dilute the focus of the analysis and complicate the nuanced challenges faced by vulnerable destinations. Given the resource constraints inherent in most water risk mitigation initiatives, targeting areas with higher risk allows for more effective and impactful application of findings. Therefore, I focused on scenarios where current or future risks are most pronounced

4.1.6. Selection of Destinations

To advance the assessment of water-related risks, a subset of countries was selected for deeper analysis using the Water Risk Filter. This selection was guided by two key criteria: the severity of water risk based on baseline water stress, seasonal variability, and projected future stress, and the operational significance of each country, measured by the number of hotels the company operates. The addition of operational importance is due to several reasons. From a business perspective, focusing on countries with a high operation density ensures that water risk assessments are both strategically relevant and practically actionable. Locations with more hotels represent a larger share of the company's water footprint, financial exposure, and brand presence. Therefore, any water-related disruptions in these countries could have a disproportionate impact on business continuity, reputation, and revenue. Moreover, a hotel uses an average of 1,500 L/room/day, which can greatly exceed that of local populations in water-scarce destinations (Sustainable Hospitality Alliance, 2018). Locations with greater operational importance translate into higher water usage. Prioritizing these locations enables the company to focus its mitigation efforts where water stewardship can yield the greatest environmental and operational benefits, while also reducing the risk of contributing to local water scarcity, community tensions, or regulatory challenges.

Based on the two criteria, water risk severity and operational significance, five countries have been selected for further analysis using the Water Risk Filter: Spain, Greece, Turkey, Mexico, and Egypt. Spain is one of the company's primary destinations, with 78 hotels in operation. It appears under both the second and third scenarios. A total of 53 hotels are flagged under these scenarios, with one hotel appearing in both. Greece hosts 32 hotels, all of which are captured under the third scenario, indicating a consistent and significant future risk profile across the entire portfolio in this country. Turkey has 27 company-operated hotels, all of which also fall under the third scenario. This uniform classification highlights widespread moderate current stress with increasing future vulnerability across the company's Turkish operations. Mexico appears across all four risk scenarios, reflecting a diverse and severe water risk profile. Of the 30 hotels operated in Mexico, eight are captured under the scenarios. Among these, three hotels appear consistently across all four scenarios, while two appear repeatedly under both the second and third scenarios. Three hotels are flagged solely under the fourth scenario. Egypt also features across all four risk scenarios. The company operates 49 hotels in the country, of which six are identified within the risk scenarios. One hotel appears across all four scenarios, three appear under both the second and third scenarios (High Current Risk, Worsening in the Future and Moderate Current Water Stress, High Future Risk), and two are flagged solely under the third scenario (Moderate Current Water Stress, High Future Risk). Table 13 summarizes the country selection and their risk profiles.

Table 13: *Summary of country selection for the Water Risk Filter analysis*

Country	Hotels	Scenarios Appeared	Hotels Identified in Scenarios

Spain	78	2 and 3	53 (1 hotel appears in both)
Greece	32	3	32
Turkey	27	3	27
Mexico	30	1, 2, 3, and 4	8 (3 in all, 2 in 2nd and 3rd, and 3 in 4th)
Egypt	49	1, 2, 3, and 4	6 (1 in all, 3 in 2nd and 3rd, and 2 in 3rd)

The Water Risk Filter requires data to be input at the site level, including operational assessment details. Given the extensive number of sites, a selection process was necessary to narrow down the focus to a manageable number of high-priority locations. Within each identified high-risk country, hotel sites were further filtered based on two key criteria: minor river basins and guest nights.

According to a study on water management and planning in the Segura River Basin by Aldaya et al. (2019), incorporating new hydrological data and perspectives is important to improve water availability understanding and promote integrated water planning. Basin-focused analyses are crucial for addressing issues which are often overlooked in broader assessments. Thus, to manage scope while preserving geographical and hydrological representativity, hotel sites within each country were grouped by minor river basins, with at least one hotel selected per basin.

Where multiple hotels were present in the same basin, the site with the highest number of guest nights was chosen to account for operational scale and potential water footprint. Guest night data refers to a single guest occupying overnight accommodation and was obtained from the company's sustainability reporting system. This criterion ensures that the selected sites reflect locations where the company's presence is most significant in terms of water use and guest impact. The data is collected for the period of October 2023 to September 2024. To align the data with the consideration of water footprint, I cross checked the number of guest nights with the size of the accommodations (number of rooms available) to ensure that the selected site not only has the highest absolute guest nights but also represents a high occupancy rate relative to its capacity. This additional step helps to account for operational intensity and ensures that the chosen site is both a major contributor to water use and represents efficient resource utilization within the basin. This combined approach balances analytical feasibility with strategic importance, enabling the identification of priority sites where water risks are both acute and operationally relevant. Table 14 summarizes the tiered screening approach and number of hotels screened in each step.

Table 14: *Tiered screening approach and the outputs*

Step	Description	Outputs
1	Initial portfolio mapping	360 destinations across 37 countries
2	High-priority countries	173 destinations across 14 countries that fall under the five scenarios
3	Country prioritization	126 destinations across five countries after screening under the two criteria: severity of water risks and operational importance
4	Basin-level distribution	126 destinations across five countries grouped into minor basins (see Table 15 for further details)
5	Hotel selection within basins	25 destinations across five countries, with one from each basin in each country, based on the number of guest nights

The fourth step of the tiered screening approach requires grouping the hotels in each country based on their minor basins. Table 15 summarizes the minor basin grouping of the hotel destinations in each country. However, on Aqueduct, minor basins are delineated using the HydroBASINS Level

6 sub-basins, each identified by a unique 6-digit code. These codes do not always correspond to locally recognized names or specific rivers. Although Aqueduct use basin names as defined by the Food and Agriculture Organization (FAO), they do not perfectly match the HydroBASINS scale. As a result, global hydrological models and local authorities may classify and name the basins differently. This thesis refers to the minor basins based on Aqueduct to maintain consistency with the platform's methodology and facilitate accurate interpretation of water risk data.

Table 15: *Groups of hotels according to minor basins*

Country	Minor Basin	Number of Hotels
Egypt	Damanhur	2
	Egyptian Northwest Coast	2
	Nile 1	1
	Wadi El Naqa	1
Spain	Barbate	1
	Guadalhorce	2
	Ibiza	6
	Majorca	32
	Minorca	7
	Onyar	2
	South Spain Coast	1
	Tagus 2	2
Greece	Corfu	2
	Crete	11
	Peneios	1
	Rhodes	9
	Sporades	8
	Zakynthos	1
Turkey	Gediz River	1
	Goksu River	12
	Mugla	14
Mexico	Ameca / Ixtapa	3
	Arroyo Caracol / Arroyo Candelaria	3
	Piaxtla / Elota / Quelite	1
	Santiago Guadalajara	1

After applying the tiered filtering methodology described above, a total of 25 hotel sites were selected for detailed water risk assessment using the Water Risk Filter.

4.2. Water Risk Classification and Analysis

This section presents the classification and analysis of water-related risks for the selected hotel destinations using the Water Risk Filter and literature review on each country. The analysis is structured around two components: basin risk and operational risk, allowing a comprehensive understanding of water challenges across both the external environment and internal operation. The first part assesses basin-level risks across the five countries to capture the multifaceted nature of water risks in each context. The second part provides an operational risk assessment, which evaluates the exposure and vulnerability of each hotel based on factors such as water dependency, supplier engagement, and existing water management practices. Both assessments are based on the PRR framework. Regulatory risks are rooted in governance capacity and aligned with SDG

Target 6.5, comprising enabling environments, institutional and governance strength, management instruments, and WASH infrastructure. Reputational risks, while often tied to operational behaviour, can also arise from basin conditions that influence public perception. These include environmental and socioeconomic vulnerabilities, as well as context-specific factors that shape whether a company is viewed as acting responsibly in its water use (WWF, 2024a).

4.2.1. Basin Risk

This section provides the results of the basin risk assessment from the Water Risk Filter, where the results will be separated into physical, regulatory, and reputational.

Physical Risk

Table 16 shows the overview of the basin physical risks of the hotels.

Table 16*: Basin physical risk*

<table>
<tr><th>Hotel</th><th>Basin Physical Risk</th><th>1. Water Availability</th><th>2. Drought</th><th>3. Flooding</th><th>4. Water Quality</th><th>5. Ecosystem Services Status</th></tr>
<tr><td colspan="7">Egypt</td></tr>
<tr><td>Hotel A</td><td>3.11</td><td rowspan="2">4.8</td><td>4</td><td>2</td><td>3.72</td><td>2.2</td></tr>
<tr><td>Hotel B</td><td>2.75</td><td rowspan="3">4.5</td><td>1</td><td>3</td><td>2</td></tr>
<tr><td>Hotel C</td><td>3.6</td><td>3.6</td><td>3.5</td><td>4.04</td><td>2.8</td></tr>
<tr><td>Hotel D</td><td>2.94</td><td>4</td><td>2</td><td>3.58</td><td>1.8</td></tr>
<tr><td colspan="7">Spain</td></tr>
<tr><td>Hotel E</td><td>3.26</td><td>3</td><td>3.5</td><td rowspan="8">2</td><td>4.32</td><td>3.7</td></tr>
<tr><td>Hotel F</td><td>3.12</td><td>2.8</td><td>3</td><td>3.9</td><td>3.9</td></tr>
<tr><td>Hotel G</td><td rowspan="3">3.33</td><td rowspan="3">3.4</td><td rowspan="3">4</td><td rowspan="3">4.36</td><td rowspan="3">3.4</td></tr>
<tr><td>Hotel H</td></tr>
<tr><td>Hotel I</td></tr>
<tr><td>Hotel J</td><td>3.31</td><td>2.8</td><td>4.5</td><td>4.22</td><td rowspan="2">3.5</td></tr>
<tr><td>Hotel K</td><td>3.2</td><td>3.2</td><td>3.5</td><td>4.1</td></tr>
<tr><td>Hotel L</td><td>3.38</td><td>2.8</td><td>4.5</td><td>3.68</td><td>4.2</td></tr>
<tr><td colspan="7">Greece</td></tr>
<tr><td>Hotel M</td><td>2.82</td><td>3.2</td><td rowspan="2">3</td><td rowspan="2">2</td><td>3.34</td><td>2.9</td></tr>
<tr><td>Hotel N</td><td>2.69</td><td>2.4</td><td rowspan="2">3.66</td><td>2.6</td></tr>
<tr><td>Hotel O</td><td>2.76</td><td rowspan="4">2.8</td><td>1.5</td><td>2.5</td><td rowspan="4">3</td></tr>
<tr><td>Hotel P</td><td rowspan="2">2.78</td><td rowspan="2">3.5</td><td rowspan="2">1.5</td><td rowspan="2">3.56</td></tr>
<tr><td>Hotel Q</td></tr>
<tr><td>Hotel R</td><td>2.76</td><td>1.5</td><td>2.5</td><td>3.68</td></tr>
<tr><td colspan="7">Turkey</td></tr>
<tr><td>Hotel S</td><td>3.4</td><td>3.4</td><td rowspan="2">4</td><td>2</td><td>4.56</td><td>3.5</td></tr>
<tr><td>Hotel T</td><td>2.68</td><td rowspan="2">2.4</td><td rowspan="2">1.5</td><td>3.24</td><td>2.8</td></tr>
<tr><td>Hotel U</td><td>2.65</td><td>2.5</td><td>3.46</td><td>3.4</td></tr>
<tr><td colspan="7">Mexico</td></tr>
<tr><td>Hotel V</td><td>3.01</td><td>2.8</td><td rowspan="2">4</td><td>2.5</td><td>2.84</td><td>3.2</td></tr>
<tr><td>Hotel W</td><td>2.85</td><td>4</td><td rowspan="2">2</td><td>2.62</td><td>2.5</td></tr>
<tr><td>Hotel X</td><td>2.69</td><td>2.2</td><td>3.5</td><td>2.92</td><td>3</td></tr>
<tr><td>Hotel Y</td><td>3.24</td><td>2.8</td><td>2</td><td>3</td><td>3.36</td><td>4.4</td></tr>
</table>

Source: Adapted from the results from the Water Risk Filter

Egypt

Egypt is facing a severe and escalating water crisis driven by population growth, declining water quality, and increasing water scarcity. Its population surged from 33.9 million in 1970 to 98.8 million in 2019 and is expected to grow by 54.9% between 2010 and 2030 (Elkholy, 2021). Annual water needs exceed supply, with a national water deficit estimated at over 90 billion m^3 , while per capita availability fell to 570 m^3 in 2018, which is well below the international threshold of 1,000 m^3 (Government of Egypt, 2021). Dependence on the Nile River makes the country highly vulnerable, especially considering upstream projects like the Grand Ethiopian Renaissance Dam, which pose additional threats to water availability and soil salinity (Aziz et al., 2019).

The hotel assessments reflect the national water stress. Hotel C emerges as the most vulnerable, with the highest combined risk scores across water scarcity (3.6), drought (4.5), flooding (3.5), and the worst water quality (4.04). All four hotels are exposed to high water availability risks, with three reporting critical drought risk levels (4.5), underscoring Egypt's heavy reliance on the Nile and minimal annual rainfall (Elkholy, 2021; Esraa et al., 2023). Water quality is a also a concern, particularly for hotels located within the Nile basin. Hotels C and A show the lowest water quality scores, in line with research pointing to pollution from settlements, municipal waste, agriculture, and aquaculture as major contributors to the Nile's degradation (Kipsang et al., 2024).

Despite these challenges, all hotels show relatively low risk regarding ecosystem services, suggesting local ecological systems still retain a degree of resilience. The overall picture indicates significant water-related stress across the board, mirroring broader national vulnerabilities.

Spain

Spain ranks among the most water-stressed countries, with over 74% of its territory at risk of desertification (OECD, 2019). Regional authorities face mounting pressure to ensure long-term water security amid intensifying climate conditions and growing tourism demands (Florido-Benítez, 2024). All evaluated hotels reflect this national water stress, with high overall basin physical risk scores ranging from 3.12 to 3.38. While flood risk remains moderate, poor water quality is the most alarming factor, with every hotel scored above 4.0, showing widespread pollution in both mainland and island locations.

Water quality concerns are especially present in the Balearic Islands. Hotels in Ibiza, Majorca, and Minorca all reported risk scores above 4.3. Studies have linked this to microplastic pollution in coastal waters (Ruiz-Orejón et al., 2018) and wastewater treatment plant (WWTP) failures during peak tourism seasons. These plants often exceed regulatory nutrient thresholds, contributing to eutrophication and marine ecosystem degradation (Rodríguez-Alcántara et al., 2024). These same hotels also report elevated ecosystem services risk scores (around 3.4), pointing to the growing vulnerability of natural systems like wetlands and coastal zones.

On the mainland, drought is a pressing concern. Hotels in Barcelona and Madrid (Hotels J and L) scored highest in drought risk (4.5), reflecting recent findings of widespread aridification across Spain, especially in June when nearly 40% of the country experienced increased dryness (Beguería et al., 2025). Hotels in Andalucia (Hotels F and K) also show high drought risk, consistent with the region's susceptibility to prolonged dry periods and municipal water restrictions (La Vanguardia, 2023; Tejada, 2023).

Overall, ecosystem services across all hotels are under considerable strain, with scores between 3.4 and 4.2. This suggests a nationwide degradation in services like water purification and biodiversity support, driven by groundwater overuse, climate pressures, and rapid urbanization

(Santos-Martín et al., 2013). In summary, hotels across Spain, whether coastal or inland, are facing interconnected risks from water scarcity, pollution, and ecosystem stress, with tourism playing a key role in intensifying these vulnerabilities.

Greece

Water distribution in Greece is highly uneven, both spatially and seasonally. Many of the country's roughly 100 inhabited islands lack sufficient water resources and rely on imports (Kourtis et al., 2019). Climate extremes further exacerbate this issue, with recurring droughts, floods, and soil erosion affecting water systems (Kourgialas, 2021). Despite these pressures, the overall basin physical risk scores for the hotels studied range narrowly between 2.69 and 2.82. This relatively tight range indicates that while no location faces extreme physical risks, underlying challenges in water availability, drought, flooding, and water quality are consistently present.

Water availability is a key concern, particularly for Hotel M (score of 3.2), reflecting moderate stress levels. The South Aegean region, where the hotel is located, is characterized by declining rainfall and a typically dry Mediterranean climate (Kaldellis & Kondili, 2007; Nastos & Zerefos, 2008; Stathi et al., 2023). Drought risks are mostly moderate to low, except for Hotels P and Q, on Rhodes and Kos, which score 3.5. These findings align with evidence that the South Aegean has shifted from sub-humid to semi-arid conditions since the 1990s, with future projections showing increased drought duration and severity (Politi et al., 2022).

Flooding risk remains minimal across most sites, with scores between 1.5 and 2.5. Localized risks, however, appear for Hotels O and R, potentially due to coastal erosion and altered drainage from tourism infrastructure. For example, 25.4% of Zakynthos's coastline has been classified as highly sensitive to coastal hazards (Zampazas et al., 2021). Water quality is a moderate concern, with scores between 3.34 and 3.68, pointing to diffuse pollution from untreated wastewater, tourism, and agriculture. Studies highlight persistent problems, particularly during peak tourist seasons, worsened by economic mismanagement during the 2009 financial crisis and COVID-19 (Stefanidis et al., 2019; Atay et al., 2024).

Ecosystem services status scores range from 2.6 to 3.0, indicating moderate strain. While not critically degraded, these ecosystems are under pressure, especially in regions like the Ionian Sea, which shows poorer status compared to the Aegean (Fraschetti et al., 2021). In summary, the hotels reflect steady, moderate water-related risks, particularly from drought and water availability , with growing stress on ecosystems and water quality due to tourism and climate pressures.

Turkey

In 2021, Turkey's annual per capita usable water availability was 1,323 m^3, placing it within the water-stressed category. With a projected population of 96.5 million by 2050, per capita water availability is expected to decline to approximately 1,161 m^3/year, pushing the country toward water poverty if total water resources remain unchanged (Öztürk & Çolak, 2023).

Data from the three evaluated hotels reflect moderate to high levels of water-related risks, with notable variation. Hotel S exhibits the highest overall basin physical risk score (3.4), driven by high water scarcity (3.4), drought risk (4), and particularly poor water quality (4.56), which is the highest among the group. Both Hotels S and U also report high ecosystem services risk, suggesting significant strain on local ecological systems. This reflects the regional concerns, where the Gediz River basin faces severe pollution from industrial discharges and agricultural runoff, leading to contamination from fertilizers and pesticides (Öztürk & Çolak, 2023; Demirel et al., 2011).

Hotel T, located in Antalya, shows a lower physical risk (2.68) but scores high in drought risk (4), aligning with projections that anticipate more frequent and intense droughts in the Mediterranean under future emission scenarios (Hertig & Tramblay, 2016; Grillakis, 2019). Antalya also faces inefficiencies in water infrastructure, losing up to 35% of drinking water in its distribution system. On a national level, water losses average around 50%, largely due to undetected pipe failures, particularly in karstic regions like Antalya, where most pipe failures in the drinking water network are not easily detectable from the surface (Akdeniz, 2022; Karadirek, 2019).

Additionally, environmental degradation is a growing issue. Nationwide wetland loss, driven by agriculture, urbanization, and infrastructure projects, has significantly reduced biodiversity and weakened ecosystem services such as water purification and flood regulation (Ataol & Onmuş, 2021). In summary, while physical water risks across the three hotels are moderate, rising drought vulnerability, persistent water quality issues, and ecosystem degradation point to a concerning trajectory for Turkey's water security.

Mexico

In Mexico, water scarcity is a growing crisis marked by prolonged droughts and increasing water demand, leading to insufficient supply, particularly in major urban centres (Martínez-Austria, 2020). This situation is especially critical for rural populations, where disparities in water access deepen vulnerability to climate-related challenges (Pacheco-Treviño & Manzano-Camarillo, 2024). Overall, water-related risk scores across all hotel locations indicate a moderate level of exposure. Among them, Hotel Y, located in Guadalajara, reports the highest basin physical risk (3.24), reflecting notable challenges in water resource management, especially regarding ecosystem services. While flooding risk remains low to moderate for most hotels (scores between 2.0 and 3.0), Hotel Y stands out with a relatively higher flood risk (3.0), likely driven by urban runoff and topographic susceptibility. The Metropolitan Area of Guadalajara has identified more than 300 flood-prone zones, with nearly 70% of the area urbanized through housing, road networks, and infrastructure development. This urban sprawl has disrupted the natural hydrological cycle, and combined with inadequate planning and water governance, contributes to the region's persistent water issues (Gleason & Flores, 2021).

Regarding water availability, Hotel W in Baja California shows the highest risk (score of 4.0), reflecting limited regional freshwater resources. As of 2017, Baja California's per capita water availability was only 849 m^3/year, making it a water-scarce region. Forecasts suggest that by 2030, the region will require a total of 4,105 hm^3 of water to escape this classification. However, the capacity of wastewater treatment and desalination infrastructure is insufficient to meet future demands (Cortés-Ruiz & Azuz-Adeath, 2020). Furthermore, as of 2025, the four active dams in Baja California are operating at only 57% of their storage capacity (Pronatura Noroeste, 2025).

Drought risk is consistently high across most locations. Hotels V and W both report scores of 4.0, while Hotel X reports 3.5. Hotel Y, however, shows a comparatively lower drought risk (2.0). Mexico's overall exposure to drought is heightened by a mismatch between rainfall distribution and demand. While the southern region receives nearly half of the country's annual rainfall, the more populous and economically active north and central regions receive just 5-10% (Dobler-Morales & Bocco, 2021).

In summary, while all hotels in Mexico experience moderate overall water risks, drought emerges as the most pressing concern for most sites. Regional disparities in water availability, combined with urbanization, ecological degradation, and inefficient infrastructure, exacerbate vulnerabilities to both hydrological stress and environmental degradation.

Regulatory Risk

Table 17 shows the overview of the basin regulatory risks of the hotels.

Table 17: *Basin regulatory risk*

<table>
<tr><th>Hotel</th><th>Basin Regulatory Risk</th><th>6. Enabling Environment</th><th>7. Institutions & Governance</th><th>8. Management Instruments</th><th>9. WASH Infrastructure</th></tr>
<tr><td colspan="6">Egypt</td></tr>
<tr><td>Hotel A</td><td rowspan="3">2.6</td><td rowspan="4">2</td><td rowspan="4">4</td><td rowspan="3">2.6</td><td rowspan="4">1</td></tr>
<tr><td>Hotel B</td></tr>
<tr><td>Hotel C</td></tr>
<tr><td>Hotel D</td><td>2.67</td><td>2.9</td></tr>
<tr><td colspan="6">Spain</td></tr>
<tr><td>Hotel E</td><td>1.22</td><td rowspan="8">1</td><td rowspan="8">1.5</td><td>1.3</td><td rowspan="8">1</td></tr>
<tr><td>Hotel F</td><td rowspan="7">1.15</td><td rowspan="7">1</td></tr>
<tr><td>Hotel G</td></tr>
<tr><td>Hotel H</td></tr>
<tr><td>Hotel I</td></tr>
<tr><td>Hotel J</td></tr>
<tr><td>Hotel K</td></tr>
<tr><td>Hotel L</td></tr>
<tr><td colspan="6">Greece</td></tr>
<tr><td>Hotel M</td><td>1.32</td><td rowspan="6">1</td><td rowspan="6">2</td><td>1</td><td>1.13</td></tr>
<tr><td>Hotel N</td><td>1.38</td><td>1.3</td><td rowspan="5">1</td></tr>
<tr><td>Hotel O</td><td>1.3</td><td>1</td></tr>
<tr><td>Hotel P</td><td rowspan="2">1.38</td><td rowspan="2">1.3</td></tr>
<tr><td>Hotel Q</td></tr>
<tr><td>Hotel R</td><td>1.3</td><td>1</td></tr>
<tr><td colspan="6">Turkey</td></tr>
<tr><td>Hotel S</td><td rowspan="3">1.55</td><td rowspan="3">1</td><td rowspan="3">2</td><td rowspan="3">2</td><td rowspan="3">1</td></tr>
<tr><td>Hotel T</td></tr>
<tr><td>Hotel U</td></tr>
<tr><td colspan="6">Mexico</td></tr>
<tr><td>Hotel V</td><td rowspan="4">2.92</td><td rowspan="4">3</td><td rowspan="4">3.5</td><td rowspan="4">3</td><td rowspan="4">1.5</td></tr>
<tr><td>Hotel W</td></tr>
<tr><td>Hotel X</td></tr>
<tr><td>Hotel Y</td></tr>
</table>

Source: Adapted from the results from the Water Risk Filter

Egypt

Egypt has 63% of the degree of implementation of IWRM (UN-Water, 2024). In 2023, Egypt's SDG 6.5.1 overall score indicates medium-high progress, with component scores of 61% for enabling environment, 63% for institutions and participation, 62% for management instruments, and 65% for financing (UN-Water, 2024).

To address growing water scarcity, the Egyptian government has launched the national water resources plan for Egypt for the period 2017-2037, which recognizes the challenges of water resources management in Egypt and sets out a roadmap for sustainable and equitable water management (Iskraemeco, 2024). The plan aims to rationalize water consumption and maximize the use of existing resources by developing alternative water sources. Key initiatives include expanding desalination in coastal governorates, constructing groundwater extraction stations, and increasing the reuse of treated wastewater. Given that agriculture accounts for most of the country's water use, the plan also promotes the adoption of efficient, technology-driven irrigation systems to enhance water productivity (Government of Egypt, 2021).

All hotels present low to medium overall basin regulatory risk, with Hotel D presenting a relatively a higher result in management instruments. The sub-indicators within this risk category shows that the location faces a very high risk regarding the density of monitoring stations as water management decisions rely strongly on data availability. In this sense, it is reported that there is no monitoring within the basin.

Another aspect that emerges as a concern is institutions and governance, where all location score a high risk of 4.0. Egypt is ranked at the 24.53rd percentile in the Control of Corruption Indicator[1]. As such, this places Egypt in the lower quartile on the ranking (World Bank, 2024). However, WASH infrastructure risk and enabling environment risk scores are relatively low for all hotels, indicating that there is an adequate access to safe drinking water, adequate sanitation and hygiene awareness across the regions, as well as existing policies, laws and plans to support IWRM implementation.

Spain

Based on UN-Water SDG 6 Data Portal, Spain has 92% of the degree of implementation of IWRM. In 2023, Spain's SDG 6.5.1 overall score indicates very high progress, with component scores of 100% for enabling environment, 100% for institutions and participation, 92% for management instruments, and 75% for financing (UN-Water, 2024).

Water policy in Spain is influenced by a range of both domestic and external factors. On the national level, key drivers include public attitudes toward water, rising environmental concerns linked to Spain's increasingly urban and service-based economy, the growing influence of stakeholders, and the country's political decentralization. Additionally, the economic downturn from 2008 to 2017 played a role in shaping policy decisions. Externally, compliance with the European Union Water Framework Directive (WFD) (European Parliament & Council of the European Union, 2000) and the seasonal spikes in water demand driven by mass tourism significantly impact water management strategies (Fornés et al., 2021).

On a more localized perspective, all hotels score very low risk in every risk category and indicator. Nevertheless, there are aspects from literature worth noting, such as the suggested application of IWRM in different aspects relating to tourism. Rodríguez-Alcántara et al. (2024) investigated the

[1] The percentile rank is based on a global distribution, where 100 represents the best performance and 0 the worst.

impact of tourism on wastewater quality in the Balearic Islands and underscored the importance of integrating IWRM principles to enhance wastewater management in tourist-heavy regions.

Florido-Benítez (2024) explored the complexities of water consumption in Spain's tourism sector, particularly in regions experiencing water scarcity, discussing the challenges of prioritizing water use between residents and tourists and emphasizing the need for sustainable water management practices informed by IWRM. Guillen and Baqué (2024) analysed Catalonia's hotel sector and assessed the availability and transparency of information on environmental sustainability and how they are communicated to stakeholders. They argue that while there is awareness and some action towards environmental sustainability, a more integrated and transparent approach is necessary. They also address how clear and innovative water management is necessary in hotels and other types of accommodation, considering the shortage of water, and saving, reuse and recycling.

As such, despite the high score of IWRM indicators, certain practical aspects need to be addressed to ensure more effective and equitable implementation. The challenges posed by tourism, such as seasonal demand fluctuations, infrastructure strain, and water-use conflicts, highlight the need for region-specific strategies within IWRM. While national-level indicators suggest strong governance and institutional readiness, the operationalization of IWRM at the local level, particularly in high-tourism zones, requires further attention.

Greece

Greece has 85% of the degree of implementation of IWRM (UN-Water, 2024). In 2023, Greece's SDG 6.5.1 overall score indicates high progress, with component scores of 94% for enabling environment, 87% for institutions and participation, 86% for management instruments, and 72% for financing (UN-Water, 2024).

Greece's commitment to IWRM is evidenced by its participation in regional initiatives and adherence to EU water directives. For example, since 2008, Greece has participated in the Non-Conventional Water Resources Programme, focusing on rainwater harvesting and greywater reuse, particularly in water-scarce communities on Mediterranean islands (Global Water Partnership Mediterranean, 2015). Moreover, Greece also has the Law No. 5106/2024 on arrangements to address the multi-level impacts of climate change in the multiple areas which represents a significant advancement in Greece's commitment to IWRM (Government Gazette of the Greek Republic, 2024). Some key provisions include the development and implementation of river basin management plans, flood and drought protection, and modernization of water utilities.

All hotels in Greece show low to very low water-related risks, with the only moderate concern being in institutions and governance, mainly due to a higher score in the Control of Corruption sub-indicator. Greece ranked in the 58.02 percentile for this indicator (World Bank, 2024), and corruption in the public sector is estimated to cost up to 14 billion euros annually (Souliotis & Maltezou, 2025).

Despite Greece's strong overall implementation of IWRM, tourism presents sector-specific challenges. Skrimizea and Parra (2019) analysed the social-ecological systems influencing water stress in tourist islands and proposed a framework that considers the dynamic interactions between tourism development and water resource management. Kourtis et al. (2019) evaluated various water management scenarios for small Aegean islands, considering the impacts of tourism and climate change. The study assessed the feasibility of different strategies, such as rainwater harvesting and desalination, to meet the increasing water demand during peak tourist seasons. The study recognizes the need for an integrated approach that includes the combination of different alternatives in determining the best course of action for dealing with water resources management problems.

In conclusion, while Greece demonstrates a strong overall commitment to IWRM and low water-related risks in the hotel sector, institutional challenges, particularly concerning governance and corruption, are still areas of concern. Additionally, there are sector-specific pressures from tourism, especially in island regions, that require integrated approaches to address the seasonal water demand fluctuations.

Turkey

Turkey has 72% of the degree of implementation of IWRM (UN-Water, 2024). In 2023, Turkey's SDG 6.5.1 overall score indicates high progress, with component scores of 80% for enabling environment, 73% for institutions and participation, 78% for management instruments, and 58% for financing (UN-Water, 2024).

Most components in Turkey score relatively high, but financing remains a challenge. Water resource projects are primarily publicly funded, but budgets often fall short, making private sector involvement increasingly important (Fanack Water, 2022). Since 1993, 1.75 million hectares of irrigation land managed by the State Hydraulic Works (DSİ) have been transferred to end-users such as farmers and cooperatives (Burak, 2008).

Following the adoption of the WFD, Turkey began aligning its water policies accordingly (Delipınar & Karpuzcu, 2017). The National Water Basin Management Strategy aimed to promote coordinated, participatory, and ecosystem-based watershed management (Ministry of Agriculture and Forestry of Turkey, 2014). Institutional mechanisms like the Water Management Coordination Board and Basin Steering Committees were established to support basin-level planning (Ersaru, 2017).

Hotels in Turkey show low to very low water-related risks, with slightly higher concerns in institutions and governance and management instruments. Delipınar and Karpuzcu (2017) noted institutional gaps, including limited authority and unclear mandates for basin committees. While stakeholders such as NGOs and water user associations are involved, their influence is largely advisory, underscoring the need for stronger governance structures.

Local case studies highlight contextual differences. In the Gediz River Basin (Hotel S), a FAO-led project has implemented erosion control, groundwater recharge, and farmer training, improved water retention and reducing climate risks (FAO, 2021). In contrast, although the Göksu Delta (Hotel T) is a Special Environmental Protection Zone, Demirel et al. (2011) found widespread pollution due to a lack of waste collection services, pointing to weak enforcement despite strong regulations. In Muğla Province (Hotel U), the Metropolitan Municipality, with private partners, is enhancing water and wastewater services, including sludge management and resource recovery strategies (Seureca Veolia, n.d.). This reflects progress in public-private collaboration.

In summary, Turkey shows a strong commitment to IWRM, supported by policy alignment and institutional frameworks. However, there are still financial and governance issues, particularly at the local level, limiting full implementation.

Mexico

Mexico has 41% of the degree of implementation of IWRM (UN-Water, 2024). In 2023, Mexico's SDG 6.5.1 overall score indicates medium-low progress, with component scores of 49% for enabling environment, 39% for institutions and participation, 41% for management instruments, and 33% for financing (UN-Water, 2024).

Mexico's National Water Law prioritizes IWRM and led to the creation of watershed councils supported by CONAGUA (Manzano-Solís et al., 2019), but local participation and enforcement remain weak. Many cities lack basic regulations, and state guidance is limited (Pacheco-Vega, 2020). Fragmented, sectoral budgets and federal control over funding constrain watershed planning and reinforce power imbalances (Tinoco et al., 2022).

All assessed hotels share a regulatory risk score of 2.92, with institutions and governance scoring highest, driven by Mexico's low rank in Control of Corruption of 17.45th percentile (World Bank, 2023). Though tools exist, local coordination is poor. Pacheco-Vega (2020) attributes this to centralized, misaligned governance that undermines polycentric management.

Further challenges include a lack of shared funding models and weak research-policy links (Ayala et al., 2022). In Guadalajara, where Hotel Y is located, water cycle monitoring is minimal, with key data on precipitation and leakage missing (Gleason & Flores, 2021). In summary, despite national-level frameworks, limited local autonomy, regulatory incoherence, fragmented funding, and poor data availability continue to hinder effective IWRM.

Reputational Risk

Table 18 shows the overview of the basin reputational risks of the hotels.

Table 18: *Basin reputational risk*

Hotel	Basin Reputational Risk	10. Environmental Factors	11. Socioeconomic Factors	12. Additional Reputational Factors
Egypt				
Hotel A	2.75	1.9	3.3	2.5
Hotel B	2.8	2.1		
Hotel C	3.1			3.7
Hotel D	3	2.9		2.5
Spain				
Hotel E	2.3	3.2	1.7	2.6
Hotel F	2.12	2.5		
Hotel G	2.62	3.3		3.8
Hotel H				
Hotel I				
Hotel J	2.45	2.6		
Hotel K	2.3	3.2		2.6
Hotel L	2.33	2.1		3.8
Greece				
Hotel M	2.48	3.7	1.81	2.6
Hotel N	1.8	2.6	1.6	1.4
Hotel O	2.35	3.6		2.6
Hotel P	2.2	3		
Hotel Q				
Hotel R	2.35	3.6		
Turkey				
Hotel S	4.02	3.7	4.3	3.8
Hotel T	3.52	2.9		2.6
Hotel U	3.55	3		
Mexico				
Hotel V	3.6	3.8	3.7	3.2
Hotel W	3.8	3.4		4.4
Hotel X	3.55	3.6		3.2
Hotel Y	3.48	2.1		4.4

Source: Adapted from the results from the Water Risk Filter

Egypt

All hotels experience medium basin reputational risk, with Hotel C in Giza showing the highest score (3.1), primarily due to additional factors (3.7) and proximity to a UNESCO World Heritage Site, Memphis and its Necropolis (UNESCO World Heritage Centre, n.d.). Heritage sites often attract scrutiny. Some experts argue that unregulated tourism linked to World Heritage designation can degrade the sites they aim to protect. For instance, at Angkor Wat, hotel development and water overuse strained the aquifer, reportedly causing subsidence of ancient monuments (Angel, 2010). Hotel D in Suez is the only one facing medium environmental risk, driven by industrial wastewater discharges into the Gulf of Suez. Heavy metal contamination from oil spills, maritime traffic, and sewage presents a high ecological threat to marine habitats (El-Safa et al., 2021).

Socioeconomic risk is medium (3.3) across all hotels, reflecting water-related conflicts. Egypt has experienced protests over water scarcity and mismanagement (Al-Youm, 2012; Ibrahim, 2012) and even cyberattacks, such as the 2020 Egyptian hack targeting Ethiopian water infrastructure amid tensions over the Grand Ethiopian Renaissance Dam (Zelalem, 2020; WWF, 2024b).

In conclusion, while environmental risks vary, socioeconomic pressures and reputational factors, especially for sites near sensitive cultural landmarks, are consistent contributors to overall basin risk. Hotel C is most exposed due to its location and high public visibility.

Spain
The basin reputational risk scores are low to medium across the board, ranging from 2.12 to 2.62. This indicates a consistent baseline of concern about water basin perception across regions, with no hotel standing out as significantly safer or riskier. The socioeconomic factors score is also fixed at 1.7 for all hotels. This uniformity implies that socioeconomic vulnerability is considered equally minimal across the selected basins. The sub-indicators also show low to very low risks in every aspect. This implies that these basins have little to no water conflicts, labour or human rights violations, and financial inequality.

However, environmental factors may emerge as a concern. Hotels in the Balearic Islands and Andalucia, particularly those near Fuente de Piedra (a Ramsar-listed wetland), show elevated concern. De-Los-Ríos-Mérida et al. (2021) found that effluent from a nearby WWTP contributes to cultural eutrophication in the wetland, highlighting how proximity to ecologically sensitive areas can raise reputational risks, especially for environmentally conscious consumers and stakeholders.

The most striking variation appears in the additional reputational factors, with a split between hotels scoring 2.6 and others scoring a high 3.8, where the higher scores are associated with tourist-heavy locations like Ibiza, Majorca, and Minorca. Interestingly, the sub-indicators show that the higher scores in this risk category are mainly driven by the high media scrutiny. For example, Spain's wastewater treatment infrastructure is under significant pressure due to the seasonal surge in tourism, especially in coastal and island regions.

Many treatment plants, originally designed for smaller populations, are now overwhelmed during peak tourist seasons, leading to environmental concerns such as untreated or poorly treated wastewater being discharged into natural ecosystems. The issue is particularly acute in the Balearic Islands and Mediterranean coast, where rapid tourism growth has outpaced infrastructure upgrades. The situation poses both environmental and reputational risks, especially in areas dependent on nature-based tourism (Water News Europe, 2024). These pressures are worsened by local water-use restrictions in regions like Catalonia and Andalucia, where residents face bans on non-essential water uses while tourism continues largely unaffected. This has raised public concerns about inequity and contributed to growing resident-tourist tensions (Florido-Benítez, 2024; O'Toole, 2024).

Moreover, during peak seasons, tourists in destinations like Majorca use 250-450 litres of water daily, which is around 25% of the island's total use. Prolonged droughts, especially in Catalonia, have worsened scarcity, leading to public unrest and even violent protests in Tenerife (Fes, 2025). Additionally, in November 2023, the European Commission referred Spain to the Court of Justice of the EU for non-compliance with the Urban Wastewater Treatment Directive in over 130 locations, including sensitive areas (European Commission, 2023). This failure to meet EU environmental standards compounds the reputational challenges in key tourist regions.

In conclusion, while baseline reputational and socioeconomic risks remain low across Spain, environmental and reputational concerns are escalating in island and high-tourism areas. These challenges are driven by infrastructure limitations, public discontent, and increased media attention, which could threaten the long-term sustainability and appeal of these destinations unless governance and investment priorities shift toward more balanced water stewardship.

Greece
The basin reputational risk scores for hotels in Greece are low to very low, ranging from 1.8 to 2.48. While all sub-indicators are based on national-level data, Corfu displays a slight deviation due to a 0.52 score difference in the water conflict indicator. Although minor and unlikely to affect the broader interpretation of risk, it is noted as a potential data inconsistency for further review.

Environmental factors are the most prominent concern, with high scores for Hotels M, O, and R in Corfu, Kyllini, and Zakynthos, respectively. These areas encompass Ramsar wetlands or other ecologically sensitive zones, contributing to elevated environmental scores. These scores are supported by documented cases showing how tourism-related activities, such as infrastructure development, increased water demand, and wastewater discharge, can negatively impact sensitive wetland ecosystems. These regions include Ramsar wetlands and other ecologically sensitive zones, where tourism-related activities, such as infrastructure expansion, increased water use, and wastewater discharge, pose threats to local ecosystems. In Zakynthos, tourism development has clashed with conservation efforts for loggerhead sea turtle nesting sites, prompting restrictions and the creation of the National Marine Park (Ruzza, 2003). Similarly, in Corfu, the proposed Kassiopi Project threatens the Vromolimni and Akoli wetlands, raising concerns and a Red Alert from environmental organizations about habitat loss and pollution (Euronatur, 2021).

A broader governance issue also underlies these risks. Syrou and Botetzagias (2022) found that environmental governance in Greece's protected areas, including Ramsar sites like Strofylia Wetland and Messolonghi Lagoons, is often perceived as ineffective, with insufficient stakeholder engagement and lack of a shared conservation vision.

Although additional reputational factor scores remain generally low, sub-indicators like Sites of International Interest highlight specific vulnerabilities. For example, Rhodes, home to a UNESCO World Heritage Site, faces overtourism during peak months, resulting in overcrowding, pollution, and resource strain, particularly water (Leventi et al., 2025; Avdikos, 2011). Other studies also support the link between tourism and water-related pressures in Greece. On Sifnos Island, Zafeirakou et al. (2022) identified water scarcity driven by seasonal tourist demand, calling for circular water management approaches like desalination and wastewater reuse. Kolokotsa et al. (2020) observed that seasonal population surges in Zakynthos affected antibiotic resistance patterns in wastewater, emphasizing the need for adaptive health strategies in tourism-heavy areas.

In conclusion, while basin-level reputational risks are low overall, hotels operating in ecologically sensitive or heritage-rich regions face location-specific environmental and reputational risks.

These are exacerbated by weak environmental governance and growing public scrutiny of tourism's impact on water resources and biodiversity.

Turkey
All hotels exhibit high basin reputational risk scores, ranging from 3.52 to 4.02. Socioeconomic factors are a major concern across the board, with a consistently high score of 4.3. Hotel S shows the highest overall risk (4.02), primarily due to elevated scores in environmental (3.7) and additional reputational factors (3.8). Hotel S is near two Ramsar sites, Gediz Delta and Lake Burdur, both facing severe environmental stress. The Gediz Delta is under threat from pollution, agriculture, urban development, and climate change (Arslan et al., 2021), while Lake Burdur, home to endemic species such as the toothcarp fish, is losing water rapidly due to irrigation, evaporation, and damming, with projections suggesting it may dry up by 2075 (Ertuğrul et al., 2017; Gözükara et al., 2019). These ecological vulnerabilities elevate reputational risks, particularly for hotels operating in such areas. Similarly, Hotel T is near the Göksu Delta, where sea turtles and blue crabs are threatened by saltwater intrusion due to over-extraction of groundwater (Demirel, 2010; Demirel et al., 2011). The presence of endemic species further amplifies reputational risks for companies operating nearby (WWF, 2024b).

Hotel U, located in Fethiye Bay, may also face scrutiny due to microplastic accumulation in the surrounding waters (Genc et al., 2019), potentially impacting guests' perception of water quality and raising expectations for visible sustainability efforts.

Socioeconomic factors show the highest risk score (4.3) across all hotels, driven by labour rights violations and financial inequality. Çivak (2023) highlights how hotel workers in Turkey face financial hardship due to insecure, seasonal work and devalued roles, particularly in all-inclusive resorts that limit guest interaction. In Bodrum, the rise of large-scale tourism enterprises has intensified tensions with local artisans and small businesses. Okuyucu (2013) notes that this shift undermines traditional craft tourism and local economies, supported by Alipour (1996), who argues that large firms' economic and global advantages exacerbate local inequalities.

Additional reputational factors vary widely (2.6-3.8), influenced by media scrutiny, heritage concerns, and proximity to protected sites. Hotel S, located in Izmir, a city with two UNESCO World Heritage Sites (Ministry of Culture and Tourism, 2023), scores highest in this category. Media reports further elevate reputational risks. In Antalya (Hotel T), increased plastic waste and coastal erosion linked to tourism and recreational development have drawn criticism (Daily Sabah, 2025; Deniz, 2019). Yiğit et al. (2022) also attribute long-term shoreline erosion in Konyaaltı to uncontrolled tourism pressure, disruption of the coastal biological balance and climate change.

Additionally, in Muğla, a resort project in Marmaris has faced legal action for encroaching on national park land, despite revoked permits (Bilgic, 2025; Bianet, 2023; Huseynova, 2025). Near Hotel U in Sarıgerme, pollution in the Sarıçay stream has put two Blue Flag beaches at risk, following previous revocations due to poor water quality with elevated levels of bacteria and suspected sewage contamination, raising concerns about the impact on tourism and environmental standards in the region (Ward, 2024).

The basin reputational risk is shaped by environmental, socioeconomic, and other factors. Hotels situated near ecologically sensitive areas face heightened scrutiny, while socioeconomic factors, such as labor issues and community tensions, elevate reputational vulnerabilities. Media coverage and proximity to protected or culturally significant sites also add on to these risks.

Mexico

All hotels show high basin reputational risk scores (3.48-3.8), with Hotel W being the highest, largely due to elevated environmental and additional reputational factors, but its score does not deviate much from the other hotels. Environmental risks vary the most, with all but one hotel scoring above 3.0. Hotel Y, located in the Guadalajara Metropolitan Area, benefits from improved conditions, possibly due to the region's climate action plan, which targets Santiago River clean-up and groundwater management (UNFCCC, n.d.). Hotels V and X face greater environmental risks. In Mazatlán (Hotel X), coastal squeeze from tourism threatens ecosystems and tourism, worsened by the lack of legal protections or restoration programmes (Aguilar et al., 2021).

Socioeconomic risks are consistently high across all hotels, driven by widespread water conflicts. Between 2020-2023, 31 disputes were recorded (Pacific Institute, 2024). A major example is the 2020 conflict in Chihuahua over water transfers to the U.S., sparking protests from drought-affected farmers (Al Jazeera, 2020). Population growth, urbanization, and climate change have also intensified competition over transboundary rivers like the Rio Grande and Colorado, heightening reputational risk from scrutiny and unrest (Hussain, 2024).

Additional reputational factors emerge as a concern, particularly for Hotels W and Y. This is driven by the presence of World Heritage Sites within their area. Hotel Y is located near the Hospicio Cabañas, while Hotel W is in Cabo San Lucas, one of the Islands and Protected Areas of the Gulf of California. Regarding the latter, threats to the marine resources of the site have been increasingly driven by over-fishing, bycatch, pollution, exotic species, tourism development and climate change (IUCN, 2020). Graciano et al. (2019) highlight that in Cabo San Lucas, water inequality is severe. Tourists consume large volumes while 57,000 residents face shortages and high costs. Desalination is subsidized for hotels, representing resource appropriation at locals' expense.

Media scrutiny further exacerbates risks. In Mazatlán, aquifer depletion and tourist overcrowding are reported as urgent concerns (Mexico News Daily, 2022; The Mazatlán Post, 2025). In Nayarit, for example, large tourism developments drive environmental degradation, restrict local resource access, and foster social exclusion, prompting calls for inclusive and sustainable planning (Thomson Reuters Foundation, 2018).

Overall, hotels in Mexico show the most variations among all the countries. Each location is driven by different types of reputational risk. Environmental challenges may be more influential on the overall score in some locations, while socioeconomic tensions over water resources and pressures from tourism growth may introduce a national level concern. Some areas may also be more prone to media scrutiny and water conflicts than the others, especially the coastal zones or locations near ecologically sensitive areas.

4.2.2. Operational Risk

This section provides the results of the operational risk assessment from the Water Risk Filter, where the results will be separated into physical, regulatory, and reputational.

Physical Risk

The physical risk scores presented in this section are largely consistent across all assessed hotels, regardless of geographic location. This is because the scores for this risk category are derived from a standardized questionnaire focused on site-level water use and operational characteristics. As most hotels operate in a similar manner, their dependence on water is uniformly high. As a result, the responses to the questionnaire tend to yield similar risk scores, particularly in terms of water scarcity and water quality indicators. As all hotels in each country are given the same value, the results will be given on a country-level view.

Operational physical water risks are high across all countries studied. Egypt faces the highest overall operational risk (4.12), primarily driven by extreme water scarcity (score of 5), despite having a relatively lower water quality risk (2.8). Spain, Greece, Turkey, and Mexico all report the same high operational risk score (3.96), also due to severe water scarcity (5), though their water quality risks are slightly lower at 2.4.

Egypt

All four hotels score 5 out of 5 in water scarcity, which represents the highest level of risk in this category. According to the results of the questionnaire, these locations face high risk due to the high dependence on water in the locations. In this sense, the hotels rely on water for sanitation, filling the pools, domestic purposes, and irrigation. As such, both quality and quantity are important to the operation of the hotels.

In contrast, the water quality scores are uniformly 2.8, indicating a moderate level of risk. This suggests that while water quality issues are present, they are not as severe or immediate as scarcity concerns. According to the results of the questionnaire, the hotels score relatively high (4.0) in terms of water quality treatment before use. This is related to the fact that all hotels operating in Egypt must go through intensive filtering and purification of water to reach, for example, drinking water standard. However, simple filtering is required in treating on-site of the water the site withdraws after its use in operations and prior to discharge. Moreover, according to the interview, the hotels in Egypt demonstrate limited effect on downstream water quality in terms of physical, chemical and biological parameters.

Spain, Greece, Turkey, and Mexico

The basin risk scores derived from the Water Risk Filter show general consistency across most assessed countries, with Spain, Greece, Turkey, and Mexico all exhibiting similar risk levels. As such, this section will present a collective analysis for the four countries with uniform scores.

All hotels score 5 out of 5 in water scarcity, which represents the highest level of risk in this category. Similar to the situation in Egypt, these locations experience high water-related risk largely due to their significant dependence on water resources. The hotels in these areas rely heavily on water for essential functions such as sanitation, filling swimming pools, and providing drinking water. Consequently, both the availability and the condition of water are critical to the continued and efficient operation of these facilities.

In contrast, the water quality scores are uniform (2.4), indicating a low risk. This suggests that while water quality issues are present, they are not as severe or urgent as scarcity concerns. All hotels operating in other countries, unlike Egypt, require only simple filtration without the need for chemical treatment and basic filtering processes before discharging used water. The hotels also show minimal impact on downstream water quality, with limited influence on physical, chemical, and biological conditions.

Regulatory Risk

The regulatory risk scores for all hotels are identical. This consistency stems from the fact that the Water Risk Filter calculates regulatory risk based on responses to a standardized questionnaire addressing site-level compliance, permitting, enforcement, and engagement with water-related regulations. As the hotels follow similar operational frameworks and corporate standards for regulatory compliance, the responses were largely uniform, resulting in the same risk scores across all countries. The analysis that follows therefore applies collectively to all locations.

This operational-level assessment should be interpreted alongside the basin risk analysis, where a detailed, region-specific explanation of the regulatory landscape in each country was provided. Together, these perspectives offer a comprehensive understanding of water-related regulatory risk across different geographic and governance contexts. Similar to basin risk, all hotels in each country are given the same value. As such, the results will be given on a country-level view.

The overall operational regulatory score for all hotels in five countries is relatively low (2.0). All hotels score 3 out of 5 in enabling environment, which demonstrates a medium risk in this indicator. This stems water-related regulation and legal enforcement that the sites are facing. It must be noted that from the interview, the answers for all the hotels were unknown, resulting in the default score of 3.0 for every location. This outcome is not necessarily reflective of actual conditions on the ground but rather a lack of specific, site-level knowledge or documentation. As such, the score should be interpreted with caution, as it highlights the need for more targeted data collection and local engagement. To obtain a more accurate assessment of regulatory exposure, direct communication with local water authorities or site-specific audits would be essential.

In contrast, the institutions and governance scores are uniform (1.0), indicating a very low risk. This suggests that the company does not face issues with compliance with legal wastewater quality standards while water quality issues. All hotels demonstrate a presence of formal regulatory mechanisms and institutional oversight, such as environmental permitting and monitoring systems. The low institutional and governance risk is likely due to standardized corporate policies and internal compliance protocols, which help ensure alignment with national and local water regulations. These practices include the use of dedicated environmental officers, regular reporting to authorities, and adherence to corporate environmental standards, all of which help to minimize the risk of regulatory breaches or enforcement actions.

The results suggest a difference between the uncertainty about regulations and the actual stability of the regulatory systems. While the enabling environment score reflects a lack of information, the low risk score for institutions and governance shows that hotels operate in areas with clear rules and reliable oversight. This likely results from strong company practices that ensure hotels follow national and local regulations, such as getting permits, monitoring water use, and reporting to authorities. These findings highlight the need for better local knowledge of how regulations are applied and enforced in each location. Although the broader regulatory systems seem strong, more detailed, site-specific information would provide a clearer picture of potential risks.

Reputational Risk
This risk category shows the most variations among the hotels in each country. This is due to the differing answers in question 8 of the interview, which focuses on the water use of the site. According to the interviewee, the answer to this question is based on the water use of the particular hotel, which is compared to the water usage in the Annual Report in the financial year 2024. The water usage data is obtained from the company's internal sustainability reporting system. The data was collected from October 2023 to September 2024. It should be noted that the timeframe of the financial year report may differ slightly from the internal sustainability reporting period; however, the comparison is intended to provide an approximate average of water use to help determine whether the hotel is considered a big water user/polluter. Table 19 shows the average water use data in the company's hotels in 2024, in comparison to the year 2023.

Table 19: Data on hotels' average water usage

Water usage	**Annual average (2024)**
Fresh water- litre/guest night	502
Water*- relative litre/guest night	620

*Including water for domestic, pools and irrigation purposes

Source: Adapted from TUI Group (2024)

The data from the annual report was used as a benchmark for water usage comparison, as it reflects the company's consolidated performance for the financial year 2024. This allows for internal consistency in data interpretation and ensures comparability across hotels within the same corporate framework. While individual hotel contexts may vary, this benchmark provides a standardized reference to identify relatively high or low water usage.

The analysis focuses on water use, which is the primary driver of variation in reputational risk scores across hotels. The remaining questions under the conflict indicator cover the local recognition of the company's brand and the maturity of water stewardship practices. However, based on the interview, the responses to these questions were consistent across all sites. Specifically, brand recognition was uniformly rated with a score of 5, indicating that the brand is well-known and recognizable to most or all residents. Similarly, regarding water stewardship, all hotels operate within a shared corporate framework that includes established water management practices. As a result, this aspect received a consistent risk score of 3 across all locations. Table 20 shows an overview of the operational reputational risks of the hotels.

Table 20: *Operational reputational Risk*

Hotel	Operational Reputational Risk	5. Conflict
Egypt		
Hotels A, B	3.4	3.4
Hotels C, D	4.6	4.6
Spain		
Hotels E, F, I, J, K, l Hotel F	3.4	3.4
Hotels G, H Hotel H	4.6	4.6
Greece		
Hotels M, O, Q, R	4.6	4.6
Hotel N	4.2	4.2
Hotel P	3.4	3.4
Turkey		
Hotel S	4.6	4.6
Hotel T	3.4	3.4
Hotel U	4.2	4.2
Mexico		
Hotels V, W, X, Y	3.4	3.4

Source: Adapted from the results from the Water Risk Filter

Egypt

According to the interview with the company representative, Hotels C and D are considered large water users/polluters, which is reflected in the risk scores. Their total water use is substantively high, when compared to the company-wide average, 620 litres/guest night (TU Group, 2024). This suggests that both properties significantly exceed typical water usage levels within the company's portfolio. The elevated consumption may be attributed to factors such as the presence of extensive landscaping, water-intensive amenities such as pools and spas, or inefficiencies in water management systems. As of the interview, there were no specific mitigation measures in place at these sites, further justifying their higher risk classification.

Spain

Similar to the situation in Egypt, two hotels in Spain, G and H, are classified as large water users and potential polluters, as reflected in their high risk scores, which likely result from the presence of water-intensive facilities on site. Both hotels operate four swimming pools each, which significantly increases water use for filling, maintenance, and sanitation. Hotel G, however, states on its website that several water-saving measures have been implemented. These include water-efficient toilet flush systems and the reuse of well-purified wastewater for non-potable purposes such as irrigation and gardening. Despite these efforts, the site-level water consumption remains high and should be considered when assessing the hotel's environmental impact and risk profile.

Greece

Four out of the six hotels (M, O, Q, and R) exhibit notably high scores of 4.6. The interviewee considered them as a large water user. These scores are reflective of the water-intensive activities and amenities provided within the hotels. For example, Hotel G, with the highest water consumption out of all the assessed hotels, has three swimming pools, as well as water sports lessons. Hotel N demonstrates a slightly lower risk score of 4.2, indicating moderate concern regarding competition over water resources or perceived impacts on local users. According to the questionnaire, the site received a score of 4.0 in relation to water use, suggesting that it consumes relatively large volumes of water, though not at the highest levels observed across the portfolio. While this score is less critical than those of the 4.6-scoring hotels, it nonetheless ranks Hotel N within a high-risk category.

Turkey

Turkey shows diverse results among the hotels, with each property receiving a different score for the water consumption aspect in the questionnaire. Hotels S and U are rated within the high to very high risk categories. However, it must be noted that, according to the interviewee, the elevated score for Hotel S may be influenced by the fact that the hotel is relatively new. As such, the higher water usage could partially be attributed to temporary factors such as ongoing construction work, initial landscaping, or the commissioning of facilities.

Mexico

Mexico displays a medium overall score. All hotels score 2.0 on their water consumption on the questionnaire., indicating that they are not a large water user. The higher score of 3.4 is driven by the other remaining questions on local recognition and water management maturity.

4.2.3. Destination Comparison

The results revealed distinct patterns of water-related risks when examined through basin and operational perspectives across the five countries. Egypt faces the highest overall risk. Basin-level challenges include extreme water scarcity due to reliance on the Nile, rapid population growth, and minimal rainfall. Drought and pollution degrade water quality, especially in the Nile Delta. Ecosystems are under heavy pressure. Operationally, all hotels score highest for water scarcity, with significant reliance on water for sanitation, pools, and landscaping. Water quality risk is moderate, requiring extensive treatment, though downstream impacts are limited. Some hotels consume over 1,100-1,300 litres/guest night, which are more than double the company average, due to high-demand amenities and lack of mitigation. Regulatory governance is stable but enabling environment scores reflect data gaps. Reputational risk is high due to water insecurity, political tensions, and visible pollution.

Spain presents moderate to high risk, particularly in the south and islands. Drought and water scarcity are common, and water quality suffers in certain basins due to poor infrastructure and agricultural runoff. Ecosystem degradation is linked to overdevelopment. Hotels rely on local water, with low quality risk and limited downstream impact. Two hotels exceed 1,000 litres/guest night, driven by pools and similar features. Some mitigation measures are in place. Regulatory risk is moderate due to incomplete IWRM adoption, while institutional governance remains strong. Reputational concerns are growing around tourism’s impact during droughts and peak seasons.

Greece has moderate national-level risk, with higher stress on islands. While drought and flood risks are not severe, water scarcity is rising due to tourism peaks and limited freshwater. Ecosystems are vulnerable, especially in tourist hotspots. Operationally, several hotels are large water users, consuming up to 1,600 litres/guest night. Risks are linked to pools, water sports, and high guest volumes. Water quality is moderately managed. Governance risks are low, though enabling environments reflect limited local data. Reputational risks are localized, tied to ecosystem pressure, desalination reliance, and waste management issues.

Turkey shows high risk across all dimensions. Drought and water scarcity are widespread, with severe water quality degradation in basins like Gediz. Ecosystems, particularly wetlands, are under stress. Hotel-level water scarcity scores are high, though usage varies. Some properties exceed 3,400 litres/guest night, partly due to new construction. Water quality risks are moderate and generally managed. Regulatory frameworks are in place but weakened by poor coordination and limited funding. Governance is strong internally but enabling environment scores indicate data gaps. Reputational risk is high due to poor environmental practices and scrutiny over tourism's impact on sensitive areas.

Mexico has regionally variable but generally high risk. Northern and coastal areas face severe water scarcity and aquifer overuse. Water quality is moderately degraded, and flooding occurs in some urban centres. Ecosystems in tourism zones are under pressure. Despite high scarcity risk, hotel water use is relatively low (268-399 litres/guest night), suggesting more efficient systems. Water quality risk is low, and basic treatment is applied. Regulatory challenges persist, with the lowest IWRM implementation score due to centralized governance and weak local coordination. While institutional compliance is strong, enabling environments remain uncertain. Reputational risk is significant due to frequent water conflicts, inequality, and media focus on tourism's water impacts. The full summary of the risks in each country can be found in Appendix E.

4.3. AWS Standard Analysis

This section examines how the AWS Standard aligns with the water management needs of tourism destinations facing high water risk. The findings highlight both the potential and limitations of applying the Standard in tourism contexts.

4.3.1. Relevance to Tourism Water Risks

The Standard is relevant to the water challenges experienced in tourism destinations. It is positioned as a catchment-scale framework, designed to help water users address challenges shared with others in the catchment and achieve social, environmental, and economic benefits (AWS, 2020). Tourism requires a comprehensive approach to managing water risks in socially and environmentally sustainable ways (Water Stewardship Indonesia, 2024). Its core outcomes, particularly sustainable water balance, good water governance, and shared water challenges, are directly applicable in destinations where tourism intersects with growing water scarcity, seasonality, and reputational pressures (Gössling et al., 2012; AWS, 2020; Geng et al., 2020).

The standard, for example, emphasizes the identification and engagement of relevant stakeholders, those who affect or are affected by a site's water use. This is particularly important in tourism destinations, where water competition between hotels, local communities, agriculture, and ecosystems is present (Hu et al., 2019; Roxas et al., 2020). Seasonal tourism surges can strain local water supplies, triggering conflict or resentment from residents who may experience water shortages or declining quality during peak visitor periods (Becken, 2014). In such settings, stakeholder engagement is not only about procedural fairness, but also a key strategy to identify shared concerns such as access, affordability, or drought resilience, and to build trust around water governance (Salamanca-Cano & Durán-Díaz, 2023).

Scholars emphasize that inequities in tourism water use are closely tied to governance dynamics. In destinations, rapid tourism development has diverted water away from agriculture and domestic uses, these power asymmetries generate uneven socio-environmental outcomes within tourism-water dynamics (Cole, 2012; Carter, 2023). Such cases underscore that water scarcity is not merely a physical or technical issue but a social and political one. For the AWS Standard to be meaningful in tourism contexts, it should go beyond hydrological aspects to account for who participates in decision-making, whose needs are prioritised, and who bears the costs of water scarcity. The AWS approach promotes identifying who has influence or interest in water issues and highlights the need to include marginalized groups such as indigenous people, women, and informal water users, who are often left out of tourism planning. This makes the criterion especially important in places with social inequalities and histories of unfair access to water.

Certain criteria within the standard are relevant for tourism destinations facing water stress. They require understanding shared catchment-level water challenges and site-specific water risks, including social impacts (AWS, 2020). These are common in tourism areas affected by seasonal demand, local water use, and climate change (Gössling et al., 2012; Becken, 2014; Gössling & Scott, 2024). By identifying these issues, sites can support more inclusive and collaborative water stewardship. Other studies also adopt this systemic perspective. Gössling et al. (2012) emphasize that tourism significantly contributes to local water consumption and can intensify resource stress in destinations with already limited supplies, such as Mediterranean islands. They argue that the scale and impact of tourism-related water use and pollution are often underestimated, indicating the need to rethink how tourism interacts with water resources, particularly by considering the broader catchment context. Richards et al. (2022) highlight the effectiveness of catchment-based water stewardship partnerships in safeguarding water security through collaboration, emphasizing engagement across private, public, and civil society sectors to address shared basin risks.

Moreover, a study by Magagni et al. (2020) illustrates the effective implementation of the AWS Standard at the Philip Morris Manufacturing & Technology in the Emilia-Romagna region of Italy, a location facing high water stress. Through AWS's 5-step certification process, the site improved its water governance, reduced potable water consumption by 20%, and enhanced stakeholder engagement at the catchment level. The AWS enabled the identification of local water-related risks, promoted intersectoral collaboration, and improved awareness of sustainable water practices both within the organization and among the broader community. While this case does not originate from the tourism sector, it provides a relevant and transferable example of how the Standard can be effectively applied in high water-risk contexts.

4.3.2. Examples in Tourism Sector

Despite the lack of clear examples of the direct application of the AWS Standard within the tourism sector, there are examples of tourism businesses implementing water stewardship practices that align with the AWS outcomes, such as improving water efficiency, engaging stakeholders in water-related issues, protecting local ecosystems, and supporting catchment-wide initiatives, even if these efforts are not formally certified under AWS. These practices correspond with the AWS Standard, which emphasizes the identification and application of context-appropriate good practices to advance sustainable water governance, balance, quality, and WASH services within and beyond the site level (AWS, 2020). In the tourism sector, good practices may take many forms, ranging from transparent public reporting of water use data to the use of wetland treatment systems and rainwater harvesting technologies. These examples demonstrate how the sector can operationalize water stewardship in ways that are relevant to local conditions, respond to stakeholder concerns, and support of long-term sustainability goals. Table 21 summarizes the good practices under the five core outcomes of the AWS Standard.

Table 21: *Good practices for AWS outcomes*

Outcome	Good Practice	Key Actions
Water governance	Public disclosure of water use and quality data	A hotel in Tenerife publicly tracks water use, averaging 700 litres per guest-night, to improve efficiency and reduce its environmental footprint.
	Comprehensive and updated water stewardship plan	Castilla Thermal Hotels in Spain use centralized monitoring for water use and leaks, reuse greywater, and regularly update water-saving measures across all properties.
	Peer organizations and stakeholders' engagement	Hilton collaborates with stakeholders, such as NGOs, investors, policymakers, suppliers, and guests, to co-develop transparent solutions for social and environmental challenges
Water balance	Install water efficient fittings	Several hotels implemented water-efficient measures such as use of dual flush toilets and/or limited filling systems, pool covering to avoid evaporation, replacement of bathtubs with shower bases, coffee machines with water recirculation system, etc.
	Undertake a leak detection and measurement assessment	
	Use of most sustainable water source(s) and water bodies available	The InterContinental Phuket Resort harvests rainwater, stores and treats it underground, and reuses it for toilet flushing to reduce marine impact.
Water Quality	Wetland treatment systems to treat wastewater	Hotels in many countries implemented constructed wetlands and high removal efficiencies were observed across multiple systems.
	Application of a 'water safety plan'	Hotel Okura implemented a Water Safety Plan that includes legionella risk prevention, real-time monitoring, ionization systems, staff training, and response protocols.
Site Maintenance of IWRAs	Establishment of wetland treatment systems to protect an IWRA from the run-of	Many hospitality projects integrate wetlands by enhancing ecosystems, managing hydrology, zoning protected and developable areas, and establishing buffers. They conduct EIAs and site analyses to understand ecological and hydrological dynamics. Some use Low-Impact Development (LID) strategies, directing runoff into treatment train systems that promote infiltration and natural filtration before discharging into wetlands when possible.
	Establishment of buffer strips	
	Establishment of regular monitoring program to observe impacts on IWRAs	
WASH Servies	Provision of sufficient supplies of safe drinking water for all workers	Hotels and resorts in Fiji are required to provide accessible, safe water and sanitation facilities for staff and visitors, including clean, gender-separated toilets with disabled access and multiple handwashing stations. Water supply is generally reliable, though seasonal low pressure and contamination risks exist, so water quality must be monitored and stored safely. Hygiene standards are maintained through regular cleaning, inspections, and staff training, with a focus on infection prevention and compliance with food safety regulations.
	Provide training for workers and their families on good hygiene practices	
	Provision of sufficient and high standard facilities for toilets and washrooms	

Sources: Cruz-Pérez et al. (2021); Castilla Termal (n.d.); Hilton (n.d.); Gabarda-Mallorquí et al. (2024); InterContinental Phuket Resort (n.d.); Justino et al. (2023); Brouwers (2024); WATG (2025); Gibson et al. (2021).

4.3.3. Limitations of the AWS Standard

Despite its strengths, the AWS Standard presents several limitations when applied to the tourism sector. One key issue is its generic design, which may limit its practical relevance for tourism operators who face highly specific challenges such as seasonal water demand, guest-driven consumption patterns, and spatial dispersion of facilities (Gössling et al., 2012). The Standard is not tailored to reflect the distinct operational models and guest expectations in hospitality settings, which can hinder adoption and relevance. Furthermore, while the Standard promotes stakeholder engagement, it provides limited guidance on navigating complex social dynamics often present in tourism destinations, particularly where tourism-related development has historically marginalized local communities or exacerbated inequities in water access (Becken, 2014; Scheyvens & Biddulph, 2018). This can make its application less effective in destinations with history of contested resource use, especially when tourism enterprises have disproportionate power over local water resources.

Another limitation is the voluntary nature of AWS certification, which may discourage initiatives by tourism businesses that lack strong regulatory incentives or reputational motivations. As a result, implementation tends to occur among large or sustainability-minded enterprises, while small and medium-sized tourism operators, who often operate in water-stressed regions, remain excluded (Dias et al., 2024). Lastly, there is limited empirical evidence of the AWS Standard's effectiveness in improving water outcomes within tourism contexts. Most documented applications are found in agricultural or industrial settings, suggesting the need for more tourism-specific case studies and best-practice examples to inform its adaptation and utility in this sector (AWS, 2020).

Coelho et al. (2020) critically examine how water-related standards and regulations apply in the hotel industry. Based on comparative case studies in tourist resorts, they found underscores while standards (including ISO-based schemes) can provide useful technical guidelines, their effectiveness often falls short without strong multi-stakeholder regulatory frameworks and enforcement mechanisms. Specifically, their analysis shows that greywater recycling may alleviate water scarcity in tourism destinations, especially where supply stresses are high, but benefits are contingent on institutional alignment, policy coherency, and consistent monitoring. Though they do not discuss the AWS Standard by name, their findings about limitations in applying sustainability standards to tourism provide an important critical lens. The results suggest that even robust standard-setting frameworks like AWS may underperform in tourism contexts without sufficient local governance integration.

Lastly, although the AWS Standard positions itself as a tool for sustainable and equitable water use, it risks becoming a form of “greenwashing”. By emphasizing universal notions of efficiency and sustainability, the standard allows companies to gain reputational benefits without necessarily addressing local water governance challenges. Its development and enforcement are dominated by transnational corporations rather than inclusive, community-led processes, raising concerns that certification may legitimize existing power imbalances rather than transform them. In this sense, AWS can serve more as a branding mechanism than a driver of substantive, context-specific water stewardship (Vos, 2015).

5. Discussion

This study explored the results of the water risk assessments and stewardship analysis through the lens of the PRR framework, linking to the overarching objective of identifying high-risk tourism destinations and appropriate mitigation strategies and water stewardship plan. By integrating Aqueduct's quantitative assessment with the Water Risk Filter and expert input, the research uncovered not only where risks are highest, but also why they occur and how they might evolve. The PRR framework proved the interdependence between risk types, such as how operational weaknesses may amplify reputational damage, or how unclear regulatory environments hinder water management. These risks are not isolated, but they are systemic and interconnected, with physical water scarcity often triggering regulatory responses or reputational scrutiny, and vice versa. For example, severe drought may lead to stricter government controls or public criticism of overuse by hotels, demonstrating the need for integrated risk assessment and response. These findings suggest that tourism operators should adopt water management models and invest in data infrastructure to move from reactive risk responses to proactive stewardship.

Findings from Spain and Greece confirm that tourism exerts a significant impact on local water resources, particularly during peak travel seasons when the demand for water from hotels and other tourist infrastructure increases sharply. This seasonal intensification of water consumption exacerbates stress on already limited supplies, especially in areas prone to water scarcity. For instance, in parts of Spain, local authorities have issued restrictions on residential water use to prioritize water availability for the tourism sector. While this decision reflects the economic importance of tourism, it has generated social tension and controversy, leading to reputational risks for hospitality companies operating in these areas. Local communities may perceive the prioritization of tourists over residents as inequitable, which can damage the corporate image.

A similar dynamic is observed in other countries of focus. In Mexico, coastal destinations such as Baja California Sur and Mazatlán face high physical risks due to drought and deteriorating ecosystem services, exacerbated by poor infrastructure and uneven rainfall distribution. In Turkey, while local risks may appear lower in specific destinations such as Antalya, systemic challenges persist. Water infrastructure inefficiencies, combined with pollution from agriculture and industry, put pressure on both water quality and quantity. Hotels near sensitive ecological and cultural areas face heightened reputational risks due to visible environmental degradation and increasing media scrutiny. Socioeconomic drivers, including seasonal job insecurity and perceived inequities between large tourism enterprises and local communities, further intensify reputational exposure. Egypt also presents a distinct case, where physical water scarcity is acute due to minimal rainfall and high dependence on the Nile River. The country is also struggling with regulatory risks driven by weak monitoring systems and governance challenges. Here, reputational risks are often shaped not only by environmental conditions but also by broader geopolitical tensions and socio-political perceptions related to water justice and national sovereignty. Collectively, these findings emphasize the systemic nature of water risks in tourism, where physical, regulatory, and reputational dimensions are deeply interconnected.

This dynamic reflects concerns raised by Becken (2014), who found that in many developing countries, tourist water use can be up to eight times higher than domestic municipal use, creating stark disparities in access and raising fundamental questions of water equity. These imbalances are especially problematic in water-scarce destinations, where domestic use contrasts sharply with high-consumption tourism. It reinforces the idea that reputational water risks are not merely about volumes used, but about perceptions of fairness and legitimacy. Hotels may operate within legal water allocations but still face backlash if communities feel excluded from access to a vital common resource. Integrating this equity lens into risk assessments and stewardship efforts is essential to prevent long-term social tensions and reputational damage.

Furthermore, this analysis shows that the AWS Standard provides a robust and practical framework for organizations aiming to engage in responsible water use, particularly through its emphasis on baseline understanding in Step 1. This initial step focuses on collecting site-specific and catchment-level water-related data, laying the foundation for context-sensitive planning and stakeholder engagement. Tools such as the Aqueduct Water Risk Atlas and WWF's Water Risk Filter can support this process by helping organizations identify and assess water-related risks across physical, regulatory, and reputational dimensions. Their integration within the AWS framework offers an evidence-based approach to evaluating risks in data-scarce environments, including tourism destinations. While these tools are not specific to the tourism sector, their use within the AWS framework may help inform transparent, structured, and equitable approaches to water stewardship by encouraging early risk identification, shared understanding among stakeholders, and informed decision-making. This opens promising directions for future research and cross-sector collaboration between tourism businesses, NGOs, and researchers.

Although peer-reviewed publications on AWS implementation in tourism operations remain lacking, studies and examples from the hotel sector still offer useful insights on actions that align with the critical elements embedded in AWS' core outcomes. Furthermore, water stewardship analyses across destinations indicate the need for catchment-level stewardship approaches, central to AWS principles. These indirect but relevant findings suggest that AWS may offer a suitable guiding framework for sustainable and equitable water management in high-risk tourism destinations, although direct sector-specific empirical validation is still needed.

The AWS Standard also presents notable limitations in tourism contexts. Its generic design may not fully address tourism-specific challenges such as seasonal demand fluctuations, dispersed infrastructure, or guest-driven consumption. Although stakeholder engagement is a core principle, the Standard offers limited guidance for navigating the social complexities common in tourism destinations, particularly where water access is contested. Moreover, its voluntary nature may discourage adoption by small and medium enterprises lacking regulatory or reputational incentives, despite often operating in high-risk areas.

6. Conclusion

This study aimed to explore how a tourism company can integrate water risk insights into their strategic planning to enhance sustainable water management in high-risk destinations, with a focus on identifying the main at-risk destinations that require urgent actions, the key water-related risks of the selected destinations, and water stewardship actions to respond to the risks discovered. Through Aqueduct, I found that out of all the destinations that the company operates in, actions must be prioritized in Egypt, Spain, Greece, Turkey, and Mexico, due to high physical risks including baseline water stress, seasonal variability, and future water stress projections, as well as other factors such as the high operational activities of the company in these countries.

Regarding key water risks, the PRR framework has proven effective in identifying the systemic risks that affect the tourism industry, both on the basin and operational levels. This includes physical risks such as drought, water scarcity during peak tourist seasons, flood risks in certain coastal areas, and water quality issues. Regulatory risks vary among the countries. Egypt and Mexico, for example, faces challenges in terms of IWRM implementation. Spain and Greece encounter issues during peak tourist seasons, where local policies may fail in addressing the increased demand of water between the tourists and local communities. Turkey lacks financial and institutional capacity in some areas of water management such as governance structures that limit authorities of the basin committees and local enforcements of water management plans. Reputational risks are present across countries. There are examples of conflicts that arise between the local communities and the tourism industry, which is sometimes perceived as a large water user. Sites operating near ecological and culturally sensitive areas also tend to face more risks in this regard.

The AWS Standard offers a valuable and adaptable framework for guiding sustainable and equitable water management in tourism destinations facing high water risk. Its emphasis on catchment-based governance, stakeholder engagement, and context-specific water risk assessment aligns well with the complex water challenges common in tourism. However, its generic structure, limited tourism-specific guidance, and voluntary nature may hinder widespread adoption, especially among small and medium-sized enterprises. To enhance its relevance and impact in tourism contexts, further adaptation, capacity-building, and case-specific evidence are needed. Nonetheless, the AWS Standard provides a promising foundation for advancing integrated, inclusive water stewardship in the tourism sector.

This study faced several limitations. Firstly, the operational assessment using the Water Risk Filter was conducted under the assumption that all hotels operate within a similar corporate framework. While this approach allowed for consistency across the analysis, it likely oversimplified key differences in how individual sites manage water. As a result, the tool produced similar trends and risk scores across most of the hotels assessed, potentially overlooking site-specific nuances. Additionally, in some cases, the scores reflect gaps in available information about a hotel's operations rather than a true representation of water-related risks. Secondly, the chosen framework for the study may not truly reflect the issue of water equity. The PRR framework addresses the issue of water equity in some aspects of the operational process, without fully capturing structural inequalities, power imbalances, or historical injustices that shape water access and governance in tourism destinations.

It is important to note that the primary data collected, particularly from hotel operations, did not directly measure equity-related outcomes (e.g., access disparities, inclusion of marginalized stakeholders, or intra-community water distribution). As such, the analysis of equity is largely inferential, based on the assumption that water scarcity in high-risk tourism destinations often exacerbates existing inequities. This is a reasonable theoretical assumption, supported by the reviewed literature. However, I recognize this as a methodological limitation. To address this, equity was considered through indirect indicators (such as conflict potential, stakeholder engagement, and infrastructure stress), and interpreted cautiously. Future research with targeted metrics on water equity is essential to deepen this dimension of analysis. Moreover, the study was based on one interview with the personnel in the company. This limited perspective may have excluded the views of other key stakeholders, such as local communities, government officials, or civil society actors, whose experiences and priorities could have led to different interpretations of water-related challenges.

Future research can adopt a multi-scalar approach to assessing water stewardship in tourism destinations. This includes conducting site-specific analyses that account for differences in hotel operations, infrastructure, and local water contexts, rather than relying on generalized corporate data. In addition, future studies can consider complementing quantitative tools used in this study with qualitative methods, such as participatory assessments or ethnographic methods that capture socio-political dynamics and the wider range of experiences and social issues in the affected communities. To fully address water equity, future research can engage with frameworks that incorporate recognition of historical injustices, power asymmetries, and rights-based approaches to water governance. Finally, involving a broader range of stakeholders, including local residents, policymakers, and civil society groups, would offer more comprehensive insights into the social dimensions of water use and the legitimacy of stewardship standards like the AWS Standard.

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Appendix A. Data Layers and Descriptions of Aqueduct 4.0

Data Layer	Description
Physical Risk: Water Availability	
1. Water Depletion	The ratio of surface and groundwater consumptive use to available renewable water
2. Baseline Water Stress	The ratio of total surface and groundwater withdrawals to available renewable water
3. Blue Water Scarcity	The ratio of the blue water footprint to the total blue water availability
4. Groundwater	Changes in groundwater levels (in mm) between the first five years (2003–2007) and the last five years (2015–2019), based on groundwater data from the Global Land Water Storage dataset (GLWS) 2.0, modeled for the years 2003–2019.
Physical Risk: Drought	
5. Drought Frequency Probability	Relative frequency probability of hydrological drought events of moderate magnitude occurring in any 1-year period
6. World Atlas of Desertification	Land degradation and environmental change across 14 different categories, considering different elements of human-environment interactions and the convergence of the evidence layer
Physical Risk: Flooding	
7. Estimated Flood Occurrence	Floods due to overflowing rivers, lakes, or oceans caused by heavy rainfall, rapid snowmelt, dams or levees breaking, or storm surges from tropical cyclones or tsunamis in coastal areas, based on the recurrence of floods within the 34-year time frame period of 1985 to 2021
8. Flood hazard	JRC's global 100-year-flood hazard map, developed using hydrological and hydrodynamic models driven by the climatological data of the European and Global Flood Awareness Systems (EFAS and GloFAS).
Physical Risk: Quality	
9. Coastal Eutrophication Potential	The potential for riverine loadings of nitrogen (N), phosphorus (P), and silica (Si) to stimulate harmful algal blooms in coastal waters
10. Nitrate-Nitrite Concentration	Predictions of nitrogen (nitrate/nitrite) in rivers, as an annual average
11. Periphyton Growth Potential	Dissolved and total nitrogen (N) and phosphorus (P) concentrations and ratios to determine which nutrient is limiting periphyton proliferation during the growing season

Appendix B. Data Layers and Descriptions of WWF Water Risk Filter

Data Layer	Description
Physical Risk: Water Availability	
1. Water Depletion	The ratio of surface and groundwater consumptive use to available renewable water
2. Baseline Water Stress	The ratio of total surface and groundwater withdrawals to available renewable water
3. Blue Water Scarcity	The ratio of the blue water footprint to the total blue water availability
4. Groundwater	Changes in groundwater levels (in mm) between the first five years (2003–2007) and the last five years (2015–2019), based on groundwater data from the Global Land Water Storage dataset (GLWS) 2.0, modeled for the years 2003–2019.
Physical Risk: Drought	
5. Drought Frequency Probability	Relative frequency probability of hydrological drought events of moderate magnitude occurring in any 1-year period
6. World Atlas of Desertification	Land degradation and environmental change across 14 different categories, considering different elements of human-environment interactions and the convergence of the evidence layer
Physical Risk: Flooding	
7. Estimated Flood Occurrence	Floods due to overflowing rivers, lakes, or oceans caused by heavy rainfall, rapid snowmelt, dams or levees breaking, or storm surges from tropical cyclones or tsunamis in coastal areas, based on the recurrence of floods within the 34-year time frame period of 1985 to 2021
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Physical Risk: Quality	
9. Coastal Eutrophication Potential	The potential for riverine loadings of nitrogen (N), phosphorus (P), and silica (Si) to stimulate harmful algal blooms in coastal waters
10. Nitrate-Nitrite Concentration	Predictions of nitrogen (nitrate/nitrite) in rivers, as an annual average
11. Periphyton Growth Potential	Dissolved and total nitrogen (N) and phosphorus (P) concentrations and ratios to determine which nutrient is limiting periphyton proliferation during the growing season

12. Toxicity Stress	The negative effects experienced by the aquatic system due to chemicals and mixtures of chemicals that are transported through and accumulate in freshwater ecosystems and negatively affect the aquatic ecosystem.
13. Mismanaged Plastic Waste	Mismanaged plastic waste in kg/year/km2 for 2015.
14. Risk of pesticide pollution	Pesticide pollution risk score (possible additive effects of pesticide pollution) and number of (pesticide) active ingredients posing a risk to the environment.
15. Total Dissolved Solids	The average monthly total dissolved solids (TDS) concentrations in mg/l to represent salinity for the ten-year period.
16. Surface Water Quality Index BOD	The average monthly biological oxygen demand (BOD) concentrations in mg/L to represent organic pollution for the ten-year period of January 2010 - December 2019
17. Surface Water Quality Index Electrical Conductivity	Salinity balance and pH alteration
Physical Risk: Ecosystem Service Status	
18. Catchment Ecosystem Services Degradation Level	Tree cover loss, using forest cover data from Landsat data at a 30-meter spatial resolution to characterize forest cover and change
19. Violation of Environmental Flows	The percentage change in frequency of Environmental Flow Envelope (EFE) lower-bound violations from the pre-industrial period to present-day conditions
20. Wetland Degradation	The percentage wetland loss as of 2020 relative to the baseline wetland extent from 1700
21. Invasive species	The presence of some of the world's worst invasive species, based on the Invasive Species Specialist Group's Global Invasive Species Database
22. River extent change	The magnitude of river extent change over the past 4 decades derived from Landsat satellite imagery
23. Fragmentation Status of Rivers	Percentage of the basins' volume considered as fragmented (e.g not classified as 'Free-flowing')
Regulatory Risk: Enabling Environment Policy and Laws	
24. Freshwater Policy Status (SDG 6.5.1)	Based on SDG 6.5.1. "National Water Resources Policy" indicator
25. Implementation Status of Water Management Plans (SDG 6.5.1)	Based on SDG 6.5.1. "National IWRM plans" indicator

Regulatory Risk: Institutions and Governance	
26. Control of Corruption	Perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests
27. Private Sector Participation in Water Management (SDG 6.5.1)	Based on SDG 6.5.1. "Private Sector Participation in Water Resources Development, Management and Use" indicator
Regulatory Risk: Management Instruments	
28. Management Instruments for Water Management (SDG 6.5.1)	Based on SDG 6.5.1. "Sustainable and efficient water use management" indicator
29. Density of Runoff Monitoring Stations	The density of monitoring stations as water management decisions rely strongly on data availability (the number of monitoring stations per 1000 km2 of the main river system)
Regulatory Risk: WASH Infrastructure	
30. Access to Basic Safe Drinking Water	The percentage of people using at least drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip
31. Access to Basic Sanitation	The percentage of people using at least basic sanitation services, that is, improved sanitation facilities that are not shared with other households
Reputational Risk: Environmental Factors	
32. Freshwater Endemism	Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Companies operating in basins with higher numbers of endemic fish species are exposed to higher reputational risks.
33. Freshwater Biodiversity Richness	Freshwater Ecoregions of the World (FEOW) 2015 data developed by WWF and TNC. Count of fish species represents freshwater biodiversity richness. Companies operating in basins with higher numbers of fish species are exposed to higher reputational risks.
34. Ramsar wetlands	The presence (risk score 5) or absence (risk score 1) of any Ramsar sites found in the List of Wetlands of International Importances
35. Ecosystem Condition	The intactness and connectivity of ecosystems as a proxy for ecosystem condition, independent of any legal or administrative delineation
36. Free Flowing Rivers FFR	The intactness and connectivity of rivers independent of any legal or administrative delineation

Reputational Risk: Socioeconomic Factors	
37. Water Conflicts	The total number of conflict events where there is violence or the threat of violence, and where water acts as a trigger for conflict, a weapon of conflict, or where water resources or systems are a casualty of a conflict per country from 1923-2023
38. Labour/Human Rights	An estimate of the extent to which people are free from government torture, political killings, and forced labour, they have property rights, and enjoy the freedoms of movement, religion, expression, and association
39. Financial Inequality	GINI Index (the extent to which the distribution of income (or, in some cases, consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution)
Reputational Risk: Additional Factors	
40. Media scrutiny	Counts and registers of documented on coal-fired power plants, fracking, hydropower (dams), land grabbing, oil sands, wastewater management, water management and water scarcity to indicate whether there has been documented negative news (e.g., incidents, criticism and controversies) related to environmental and social issues that can affect a company's reputational risk
41. Risk Preparation	The assessment of humanitarian crises and disasters. It can support decisions about prevention, preparedness and response
42. Sites of international interest	The presence (risk score 5) or absence (risk score 1) of any World Heritage List sites produced by UNESCO

Source: Adapted from Kuzma et al. (2023)

Appendix C. Three-Level Hierarchy of the Operational Risk Assessment Framework

Risk Type		Risk Category	Risk Indicator
PHY - PHYSICAL	ORC1 - Water Scarcity	Yes	O1 - Form of water consumption
		Yes	O2 - Importance of water in operations
			O3 - Historical issues with shared water challenges
			O4 - Total water withdrawn (approximate)
			O4a - Specific water withdrawal
			O4b - Fresh surface water withdrawal
			O4c - Brackish surface water withdrawal
			O4d - Groundwater withdrawal
			O4e - Seawater / ocean water withdrawal
			O4f - Produced / processed water withdrawal
			O4g - Third-party water withdrawal
			O5 - Total water discharged (approximate)
			O5a - Specific water discharge
			O5b - Discharge to fresh surface water
			O5c - Discharge to brackish water
			O5d - Discharge to groundwater
			O5e - Discharge to seawater/ocean water
			O5f - Discharge to long term storage
			O5g - Discharge to third-party
			O6 - Water-intensive energy source dependence
	ORC3 - Water Quality		O7 - Total wastewater discharged into environment
			O7a - Amount of Nitrogen discharged
			O7b - Amount of Phosphorus discharged
		Yes	O8 - Treatment requirements - before use
		Yes	O9 - Treatment requirements - prior to discharge
			O10 - Toxic chemicals used or stored on site
		Yes	O11 - Ability to impact downstream water quality
BRG - REGULATORY	ORC5 - Enabling	Yes	O12 - Regulatory scrutiny facing site
			O13 - Planned regulatory changes
	ORC6 - Institutions & governance	Yes	O14 - Quality standards compliance
			O15 - Historical penalties or fines
			O15a - Amount of fines/penalties
			O16 - Presence and participation in basin stakeholder water
BRP - REPUTATIONAL	ORC11 - Media Scrutiny		O17 - Local media exposure
			O18 - Global media exposure
	ORC12 - Conflict	Yes	O19 - Relative water use of site within basin (User/Polluter)
		Yes	O20 - Local brand recognition
		Yes	O21 - Water stewardship maturity
			O22 - Involvement in water disputes with others
Other			O23 - Annual production volume
			O24 - Production unit
			O25 - Approximate production value
			O25a - Specific production value
			O26 - Currency
			O27- Number of employees
			O28 - Comments

Source: WWF (2024a), p.8

Appendix D. Questions and Responses for Operational Risk Assessment

No.	Question	Responses
Physical Risk: Water Scarcity		
1	In which ways does the site use water?	1 - Domestic purposes (drinking water & sanitation) only
		2 - Majority used for domestic purposes (drinking water & sanitation) with some used for processing or cleaning
		3 - Unknown OR Majority of water is used for processing purposes, with some water used for some cleaning or domestic purposes (drinking water & sanitation)
		4 - Majority of water is used for processing and cleaning purposes, with some water added to products, and some used for domestic purposes (drinking water & sanitation)
		5 - Majority of water used is added into the product, with some water used for processing, cleaning or domestic purposes (drinking water & sanitation)
2	How important is the current and future use of water quantity and quality for operating/processing at this site?	1 - Water is unnecessary/not important at all for this site
		2 - Water is needed but not very important for this site
		3 - Water quantity and/or quality is somewhat important (neutral) for this site
		4 - Water quantity and/or quality is important for this site
		5 - Water quantity and/or quality is critical (vital) for this site
Physical Risk: Water Quality		
3	Is it necessary to treat/purify on-site the water the site withdraws before its use in operations?	1 - No filtering or purification is required
		2 - Yes, very simple filtering is required (e.g. to reach cooling water standards)
		3 - Yes, some filtering is required (no chemical cleaning, e.g. to reach washing water standards)
		4 - Yes, intensive filtering and purification is required (e.g. to reach drinking water
		5 - Yes, highly intensive filtering and purification is required (e.g. ionisation)
4	Is it necessary to treat/purify on-site the water the site withdraws after its use in operations and prior to discharge?	1 - No filtering or purification is required
		2 - Yes, very simple filtering is required (e.g. to reach cooling water standards)
		3 - Yes, some filtering is required (no chemical cleaning, e.g. to reach washing water standards)
		4 - Yes, intensive filtering and purification is required (e.g. to reach drinking water standards)
		5 - Yes, highly intensive filtering and purification is required (e.g. ionisation)
5	What is the potential impact of the site's operations on downstream water quality in terms of physical, chemical and biological parameters?	1 - Negligible or very limited affect on downstream water quality
		2 - Limited affect on downstream water quality
		3 - The site moderately affects downstream water quality
		4 - The site strongly affects downstream water quality (for a small reach)
		5 - The site very strongly affects downstream water quality (for a moderate to extensive reach)
Regulatory Risk: Enabling Environment		

6	Relative to other water users in your local catchment (~ 50km radius), does this site face heavy water-related regulation and legal enforcement?	1 - No, the site is under no/minimal regulation and/or legal enforcement
		2 - No, the site is under similar regulation and/or legal enforcement as other users
		3 - Unknown
		4 - Yes, possibly the site is under greater regulation and/or legal enforcement
		5 - Yes, the site is under much greater regulation and/or legal enforcement (amongst the most targeted in the basin)
Regulatory Risk: Institutions & Governance		
7	Is the site always in compliance with legal wastewater quality standards?	1 - Company meets all existing quality standards and has either a company standard and/or has a compliance system in place
		2 - Site meets water quality requirements, but no company-specific standards or compliance systems exist
		3 - Unknown or in general meets water quality standards, but may have some violations
		4 - The site sometimes meets water quality standards, but is regularly in violation
		5 - The site rarely or never meets existing water quality standards
Reputational Risk: Conflict		
8	Relative to other water users in your local catchment (~ 50km radius), would you consider the site a large water user/discharger?	1 - No, the site is not a large water user
		2 - No, the site is not a large water user/polluter (relative to others)
		3 - Unknown
		4 - Yes, the site uses relatively larger amounts of water/pollutes, but we would not consider it high
		5 - Yes, the site is a large water user/polluter
9	Relative to other water users in your local catchment (~ 50km radius), is the company associated with the site a recognized brand (to the local public)?	1 - No, the site is not a recognizable brand to locals
		2 - To some, the site is a recognizable brand to locals
		3 - Unknown
		4 - Yes, the site is a recognizable brand to some locals
		5 - Yes, the site is a recognizable brand to most/all locals
10	How would you describe this site's general water management/stewardship maturity?	1 - Long standing advanced water stewardship practices
		2 - Recently began advanced water stewardship practices
		3 - Established Water Management
		4 - Initial actions on water
		5 - No action(s) on water

Source: ~~Adpated~~Adapted from WWF. (n.d.).

Appendix E. Water Risk and Opportunities and the Country Level

<table>
<tr><th colspan="3">Egypt</th></tr>
<tr><th>Physical Risks</th><th>Regulatory Risks</th><th>Reputational Risks</th></tr>
<tr><td>Major National Challenges:
- Rapid population growth and severe water scarcity.
- Annual per capita water availability dropped to 570 m³ in 2018 (well below international standard of 1,000 m³).
- Heavy dependence on the Nile and vulnerability to upstream developments (e.g., Grand Ethiopian Renaissance Dam).
Hotel-Specific Risk Findings:
- Hotel C has the highest overall risk: high water scarcity, drought, flooding, and worst water quality.
- All hotels show very high drought risk, high to very high water scarcity and poor water quality.
- Low risk in ecosystem services status, suggesting some environmental buffering.
Key Drivers:
- Poor rainfall (~20mm annually), over-dependence on a single water source (Nile), municipal waste discharge, agriculture, and fish farming pollution</td><td>IWRM Implementation Score: 63% (Medium-High Progress)
Key Policies & Actions:
- National Water Resources Plan (2017–2037): Focuses on consumption rationalization, desalination, groundwater use, and wastewater reuse.
- Bahr al-Baqar WWTP: World's largest wastewater treatment plant for agricultural reuse (5 million m³/day).
Local Risks: Medium regulatory risk; weak monitoring systems; high corruption risk.
Strengths: Adequate WASH infrastructure and policy environment.</td><td>Overall Reputational Risk:
- Medium overall risk across all hotels.
- Hotel C (Giza) shows the highest risk, driven by high Additional Reputational Factors, due to proximity to a UNESCO World Heritage site (Memphis and its Necropolis).
Environmental Factors:
- Varies across regions.
- Hotel D (Suez) faces medium risk due to industrial pollution and ecological threats in the Suez Gulf from heavy metals, oil spills, and potential species migration due to canal expansion.
Socioeconomic Factors:
- Consistently medium for all hotels.
- Examples include water-related protests (2012), cyberattacks linked to the Nile dam dispute (2020), and ongoing conflicts over water access, scarcity, and political tensions.
Overall Insight:
- Socioeconomic tensions and reputational concerns around heritage and conflict-prone areas drive risk levels.
- Public scrutiny significantly impacts perceived risk more than actual environmental degradation in some cases.</td></tr>
<tr><th colspan="3">Spain</th></tr>
<tr><td>Major National Challenges:
- Spain is the 3rd most water-stressed country in Europe; 74% of territory at desertification risk.
- Poor water quality and stressed ecosystems are widespread.
Hotel-Specific Risk Findings:
- All hotels show high overall risk.
- Balearic Islands hotels (G, H, I) show highest water quality risk.
- Drought risk is very high in Barcelona (Hotel J) and Madrid (Hotel L).</td><td>IWRM Implementation Score: 92% (Very High Progress)
Key Policies & Actions:
- National decentralization and EU directives.
- Seasonal tourism-driven water demand.
Local Risks: Very low across all categories.
Challenges: IWRM integration in tourism-heavy areas still needs</td><td>Overall Reputational Risk:
- Low to medium across all hotels.
- Higher in tourist-heavy regions like the Balearic Islands (Ibiza, Majorca, Minorca) due to Additional Reputational Factors (media scrutiny, water overuse, pollution).
Environmental Factors:
- Generally low risk but higher in Balearic Islands and Andalucia near Ramsar wetlands (e.g., Fuente de Piedra).
- Overburdened wastewater systems due to tourism, pollution, and EU legal action for violations of the Urban Wastewater Treatment Directive.</td></tr>
</table>

- Ecosystem Services Status scores are uniformly high, indicating widespread environmental degradation. **Key Drivers**: - High microplastic and nutrient pollution, inefficient WWTPs during tourist season, and aridification trends. - COVID-19 lockdown showed that reduced tourism led to better water quality.	improvement (e.g., Balearic Islands, Catalonia). **Opportunities**: Strong governance but room for better local-level execution.	**Socioeconomic Factors**: - Uniformly low risk, indicating minimal water-related conflict or inequality. **Overall Insight**: - Tourism hotspots face growing environmental and reputational pressures despite low conflict levels. - Water scarcity and infrastructure strain are raising tensions between residents and tourists, risking future instability and reputational harm.
Greece		
Major National Challenges: - Uneven water distribution; many islands import water. - Climate extremes causing increased drought and erosion. **Hotel-Specific Risk Findings**: - Moderate and consistent overall risk scores. - Highest water availability concern: Hotel M. - Highest drought risk: Hotels P (Rhodes) and Q (Kos). - Flood risk is minimal overall but localized risks exist (e.g., Zakynthos). - Water quality scores reflect mild-to-moderate degradation. **Key Drivers**: - Decreasing rainfall, pollution from tourism and agriculture, past mismanagement during financial and pandemic crises.	**IWRM Implementation Score**: 85% (High Progress) **Key Policies & Actions**: - NCWR Programme: Rainwater harvesting, greywater reuse. - Law No. 5106/2024: Climate and water management integration. **Local Risks**: Low overall, but higher in governance due to corruption **Challenges**: Seasonal tourism demand on islands; need for integrated, multi-strategy responses	**Overall Reputational Risk**: - Low to very low across all locations - Minor deviation in Corfu due to slightly elevated water conflict indicator. **Environmental Factors**: - Elevated risks in Corfu, Zakynthos, and Kyllini due to proximity to Ramsar wetlands and ecologically sensitive zones. - Notable concerns include tourism pressure on sea turtle habitats (Zakynthos), wetland degradation (Corfu), and infrastructure impacts on protected areas. **Socioeconomic Factors**: - Uniformly low risk; national indicators show minimal water-related conflict or inequality. **Overall Insight**: - Site-specific environmental risks may attract scrutiny, especially near Ramsar or UNESCO-designated areas. - Weak governance in protected areas and tourism-induced ecological strain could increase future reputational vulnerabilities
Turkey		
Major National Challenges: - Per capita water availability approaching scarcity thresholds; projected to decline further by 2050. - Droughts expected to intensify with climate change. **Hotel-Specific Risk Findings**: - Hotel S: highest overall risk with extreme water quality risk.	**IWRM Implementation Score**: 72% (Moderate-High Progress) **Key Policies & Actions**: - National Water Basin Management Strategy - Moves toward WFD alignment. **Local Context**: - Generally low risks in hotels.	**Overall Reputational Risk**: - High across all hotels, with Hotel S scoring highest. - Driven by socioeconomic challenges and location near sensitive natural and cultural assets. **Environmental Factors**: - High risk for hotels near Ramsar sites (Gediz Delta, Lake Burdur, Göksu Delta).

- Hotel T (Antalya): lower overall risk, but high drought. - Ecosystem Services Status is moderate to high, reflecting ecological degradation. **Key Drivers**: - Pollution in Gediz and Göksu Rivers from agriculture and industry. - Wetland loss, water infrastructure inefficiencies (e.g., Antalya loses ~35% of water supplied), and system leaks.	- Varying local issues (e.g., Gediz & Göksu Rivers face pollution and governance gaps). **Challenges**: Financing shortfalls, limited institutional capacity, ineffective stakeholder representation.	- Issues include habitat loss, pollution, lake desiccation, and microplastic accumulation. **Socioeconomic Factors**: - Very high risk, due to labor rights issues, seasonal job insecurity, and income inequality. - Tensions between large-scale tourism businesses and local communities further exacerbate reputational risks. **Overall Insight**: - Media scrutiny and environmental degradation near UNESCO sites increase public visibility of risks. - Rising pressure from tourism development and weak stakeholder inclusion heighten reputational concerns.
Mexico		
Major National Challenges: - Ongoing water crisis from drought and uneven rainfall distribution. - Rural communities face severe access disparities. **Hotel-Specific Risk Findings**: - Hotel Y (Guadalajara): highest overall risk, moderate flood risk. - Hotel W (Baja California Sur): highest water availability risk with significant drought and scarcity concerns. - Hotel V & W: highest drought risks - Ecosystem Services Status shows degradation across most sites. **Key Drivers**: - Urbanization, poor water management, inadequate infrastructure, unequal rainfall (north and center are dry, but heavily populated). - Baja California's dams and infrastructure insufficient to meet 2030 demand.	**IWRM Implementation Score**: 41% (Low-Medium Progress) **Key Issues**: - National Water Law supports IWRM in principle. - Weak local governance limited regulatory enforcement, and poor coordination. - Highly centralized structure hampers local autonomy. **Local Risks**: Medium-high across most categories; high corruption risk **Data Gaps**: E.g., Guadalajara lacks key monitoring systems. **Barriers**: Poor communication between science and policy, weak collaboration, budget fragmentation.	**Overall Reputational Risk**: - High across all hotels - Variation in risk drivers between locations, some show higher environmental risks, others more social or reputational. **Environmental Factors**: - Elevated in coastal areas (e.g., Mazatlán, Cabo San Lucas) due to overdevelopment and poor coastal management. - Lower in Guadalajara, likely due to stronger governance and climate action plans. **Socioeconomic Factors**: - Very high due to widespread water conflicts, particularly over shared river basins (e.g., Rio Grande, La Boquilla Dam). - Tourism water use often prioritized over local communities, raising equity and justice concerns. **Overall Insight**: - Coastal tourism intensifies pressure on land, water, and communities. - Inequitable water distribution, inadequate regulations, and local resistance contribute to high reputational risk.

Source: Own Interpretation